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BULLETIN NO. 32—1910
BUREAU OF EDUCATION

COURSES IN MECHANICAL AND FREE-HAND DRAWING

FOR USE IN
TRADE AND INTERMEDIATE SCHOOLS

MANILA
BUREAU OF PRINTING
1910

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INTRODUCTION.

No suitable outline for instruction in mechanical and free-hand drawing for intermediate grades has ever been prescribed heretofore by the Director of Education for use in Philippine schools. The need for such an outline is urgent. It is believed that this need will be well met by the present manual. As prepared by the committee, it bears very close relation to the constructive work of industrial instruction now offered in trade and manual training schools of intermediate grade.

The manual is designed to meet the requirements of three classes of pupils:

First, pupils in trade schools. These spend the greater part of their school day in actual manual labor in the shops. The course of study pursued by them, as outlined hereinafter, requires that they devote considerably more time to the subject of drawing than do students in other schools of similar grade. Their drawing work is closely allied to their shop work.

Second, pupils enrolled in ordinary intermediate schools but taking manual training as a subject of study coördinate with the various academic branches. The drawing work as outlined for these students in the three years of the intermediate course is the same as that completed by students in trade schools in their first year.

Third, pupils enrolled in intermediate grades who do not take trade or manual training courses. The work for these pupils as indicated in Part III of this manual constitutes a course in free-hand and decorative drawing, and is particularly designed to meet the needs of classes in domestic science and household arts.

This manual was prepared in consultation with the Director of Education and the Second Assistant Director by the following committee of industrial teachers of the Bureau of Education:

Mr. BRUCE E. INGERSOLL, Chairman, Inspector of Trade Schools for the Philippines.

Mrs. HELEN M. FREEMAN, Instructor in charge of Drawing Department, Philippine Normal School.

Mr. GEORGE HOFSTETTER, Instructor in charge of Drawing Department, Philippine School of Arts and Trades.

Mr. CANDIDO M. ALCAZAR, Principal, Manual Training School of Oriental Negros.

Mr. MEYER SCHEER, Principal, Trade School of Laguna.

Nearly all of the drawings used in this manual were made in the Philippine School of Arts and Trades.

FRANK R. WHITE,
Director of Education.

MANILA, *July 26, 1910.*

PART I.

SUGGESTIONS TO TEACHERS.

Particular attention should be given to the chapter on the use and care of instruments. There may be differences of opinion concerning the appropriateness of some of the instructions contained therein; but it has been found by experience that these instructions, if followed closely, will be very helpful in teaching the rapid and skillful use of the drawing instruments.

Before attempting to make a drawing on good paper, every pupil taking one of these courses in mechanical drawing should learn to make a neat free-hand working sketch and should submit it to the teacher for approval. For this purpose manila paper has been prescribed as part of the drawing-room equipment. All finished drawings should be made on superior drawing paper, using one of the two sizes mentioned in Part II. On an average, one out of every three drawings should be finished in ink. If blue prints are not available, the pupil should take his free-hand sketches to the shop and work from them, thus saving his finished drawings for his own future reference. Our chief aim in preparing this course is to teach the pupil to be able to make a drawing which he can use as a guide in the shop. He should be able to read, and work from, any working drawing without continually running to the shop teacher for explanations of the work assigned to him. With the exception of the practice plates, all drawings which have no direct bearing on shop work should be eliminated from the mechanical drawing courses. A few problems in geometric drawing are given in the Appendix to this manual. These problems are not to be drawn by the pupils. When it becomes necessary to use any of the principles involved in the problems given in the Appendix, these problems may be put on the blackboard by the teacher and discussed in the class.

Attention is invited to the work outlined for the first year trade course, which is also to be taught to the pupils in manual training. Owing to the small amount of time allowed for mechanical drawing in the manual training classes, the work outlined for the first year trade pupils will be all that can be accomplished by the manual training pupils in their entire course.

TIME TO BE DEVOTED TO THE COURSES.

(*a*) The mechanical drawing for the trade course will require ninety minutes per day during the entire first year; ninety minutes three times a week for the second year, and ninety minutes twice a week for the third year.

NUMBER OF HOURS FOR EACH YEAR.[1]

Forty weeks of 5 days each give 200 school days per year.
Two hundred days of 1½ hours each give 300 hours per year.
Deduct for 20 holidays of 1½ hours each .... 30 hours[2]
Deduct for 6 examination days of 1½ hours each .... 9 hours

Total to be deducted .... 39 hours
Balance remaining for actual work, per year, 261 hours.
First year, 5 periods per week, 1½ hours each, 261 hours.
Second year, 3 periods per week, 1½ hours each, 157 hours.
Third year, 2 periods per week, 1½ hours each, 104 hours.

(*b*) The mechanical drawing for the manual training classes will require two eighty-minute periods per week for three years. This work may alternate with the shop work as follows: Monday, Wednesday, and Friday for shop; Tuesday and Thursday for drawing.

---

[1] The "hours" mentioned are not "periods."

[2] Since these calculations were made two school holidays have been dropped from the list and the mid-year examinations have been abolished. However, this will not materially change the time ratios and allowances herein prescribed, as usually a few special holidays per year may be expected.

The time for this course is eighty minutes twice a week throughout the three years; but in order to deduct the proportional time lost by holidays and examinations, it is necessary to start with a basis of five days per week as follows:

	Minutes.
200 days of 80 minutes each give	16,000
Deduct for 26 days (holidays and examinations)	2,080
Balance remaining for actual work	13,920

For two periods per week take two-fifths of 13,920, which gives 5,568 minutes or 92 hours and 48 minutes. Therefore each grade will have 92 hours and 48 minutes of actual work.

(*c*) For free-hand and decorative drawing the time allowed is eighty minutes twice a week.

DRAWING-ROOM FURNITURE AND ARRANGEMENT.[1]

A drawing room must be well lighted. The north light is the best. The drawing tables should be arranged so that when the pupil is leaning over the table the strongest light will fall over his left shoulder. Afternoon sunshine should be avoided if possible.

A drawing room should contain such furniture as will enable the teacher to store safely all drawing instruments, supplies and finished drawings. The following list is recommended, and should be built along the lines suggested in figs. 1, 2, 3, and 4.

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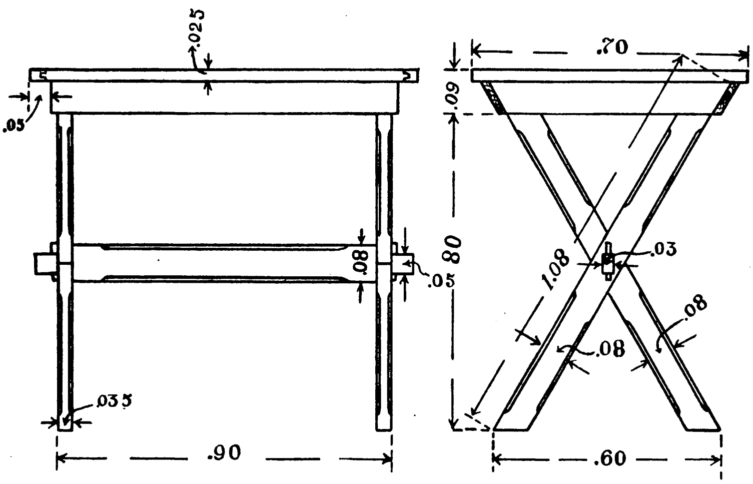
[1] Measurements expressed in meters in accordance with Act No. 1519.



SIDE AND END ELEVATION OF DRAWING TABLE

Fig. 1

BILL OF MATERIAL FOR DRAWING TABLE (Fig. 1).

[Finished dimensions.]

Part.	Number of pieces.	Thickness.	Width.	Length.
Leg	4	0.035	0.08	1.08
Rails	2	.02	.08	.94
Rails	2	.02	.08	.60
Center brace	1	.035	.08	1.00
Pins	2	.01	.025	.10
Top	1	.025	.70	1.00

NOTE.—Instead of the tongue-and-groove joint between the end cleats and the top boards, the cleats may be nailed on. The top should be made of redwood, pine, lauan, calantas, or other soft wood. The other parts may be made of tangili, apitong, amuguis, guijo, or any medium grade of wood.

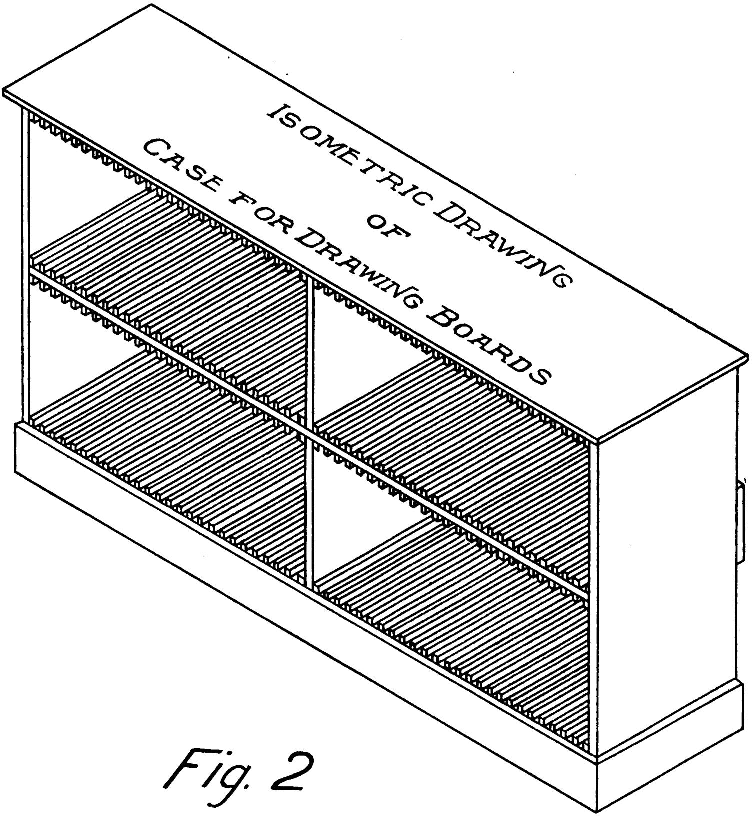


Fig. 2

BILL OF MATERIAL FOR DRAWING-BOARD CASE (Fig. 2).

[Finished dimensions.]

Part.	Number of pieces.	Thickness.	Width.	Length.
Top	1	0.02	0.38	1.81
Bottom	2	.02	.35	.835
Sides	2	.02	.35	1.18
Center	1	.02	.35	.655
Center	1	.02	.35	.505
Shelf	1	.02	.35	1.69
Base	2	.02	.15	1.77
Base	2	.02	.15	.39
Guides	208	.01	.015	.35
Back	1	.02	.20	1.73
Cleats	2	.02	.05	.35

Unless a place is designated for drawing boards, they will be scattered around the room and in a short time many of them will be broken and otherwise rendered unfit for use. In fig. 2 is given an isometric drawing of a drawing-board case large enough to accommodate one hundred boards 0.35 by 0.50. The case itself takes up but little space and makes a safe depository for the boards. Whatever drawings a pupil may be making may be left on the board when it is put into the case. The slides are 0.01 by 0.015, extending 0.35 back, and a space of 0.023 is left between them for the reception of the board. The baseboard is 0.15 wide and extends around the case.

Any medium grade of lumber may be used for this case.

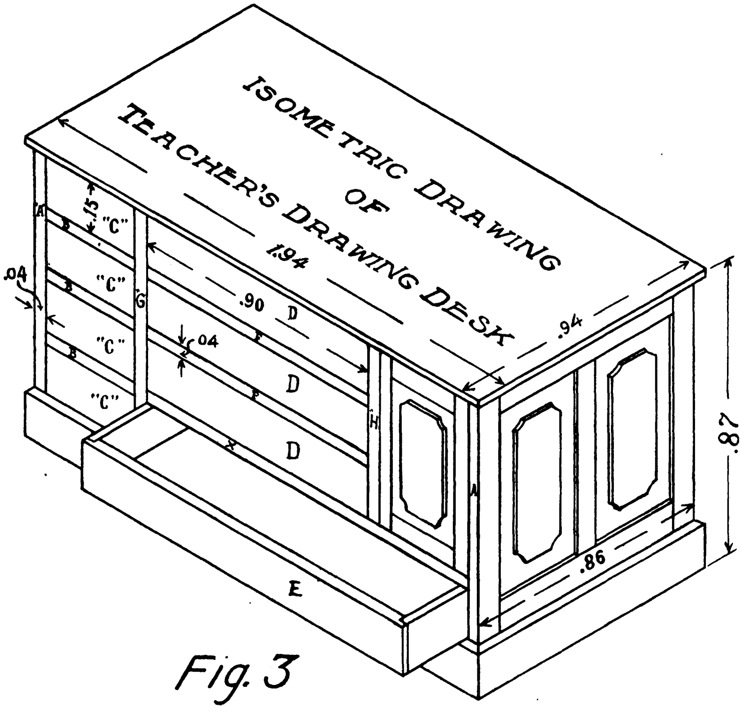


Fig. 3

BILL OF MATERIAL FOR TEACHER'S DRAWING DESK (Fig. 3).

[Finished dimensions.]

Part.	Number of pieces.	Thickness.	Width.	Length.
Top	1	0.025	0.94	1.94
Side frame ("A")	4	.04	.10	.87
Top rails	2	.025	.10	.76
Bottom rails	2	.025	.15	.76
Panel	4	.015	.31	.55
Frame, center	2	.025	.10	.58
Base	2	.025	.15	.91
Base	2	.025	.15	1.91

DRAWERS "C."

Front	4	0.025	0.15	0.38
Sides	8	.015	.15	.60
Bottom	4	.01	.36	.59
Back	4	.015	.13	.35

DRAWERS "D."

Front	3	0.025	0.15	0.90
Sides	6	.015	.15	.60
Bottom	3	.01	.59	.88
Back	3	.015	.13	.88

DRAWER "E."

Front	1	0.025	0.15	1.36
Sides	2	.015	.15	.82
Bottom	1	.01	.82	1.34
Back	1	.015	.13	1.34

FRONT FRAMEWORK.

"B"	3	0.07	0.04	0.41
"F"	2	.07	.04	.93
Below "E"	1	.025	.04	1.36
"G"	1	.10	.04	.87
"H"	1	.07	.04	.55
"X"	1	.07	.04	1.39
Lower drawer "C"	1	.025	.04	.38
Drawer stops	4	.025	.05	.87
Door frame	2	.025	.05	.53
Door frame	2	.025	.05	.32
Panel	1	.015	.24	.45
Drawer slides	16	.025	.025	.765
Drawer guides	16	.015	.025	.735
Bottom of locker	1	.015	.365	.81
Left side of locker	1	.01	.515	.81
Cleats for bottom	2	.025	.025	.81

BACK.

Part.	Number of pieces.	Thickness.	Width.	Length.
Back bottom rail	1	0.025	0.15	1.78
Top rail	1	.025	.10	1.78
Framing	5	.025	.10	.58
Panels	4	.015	.335	.55

Accessories: 12 brass drawer-pulls; 1 pair brass hinges; 9 Y. & T. drawer locks.

A teacher's desk is an important piece of furniture in a drawing room. In fig. 3 is given an isometric drawing of a teacher's desk and drawing table combined. The row of drawers on the left side may be used for records, while the drawers "D" may be used for finished drawings, one drawer for each grade. Finished drawings should always be preserved by the teacher until the end of the year, and a clean place is indispensable for keeping them. Drawings handled carelessly or left lying about will soon look shopworn. An envelope of manila paper slightly larger than the small-size drawing sheet should be made by each pupil, and in it the finished drawings should be placed for safe-keeping. In the large drawer at the bottom of the desk the large white drawing paper may be kept. In the locker to the right may be kept such supplies as the instrument case will not accommodate.

The lumber for this desk may be the same as that used for the drawing tables.

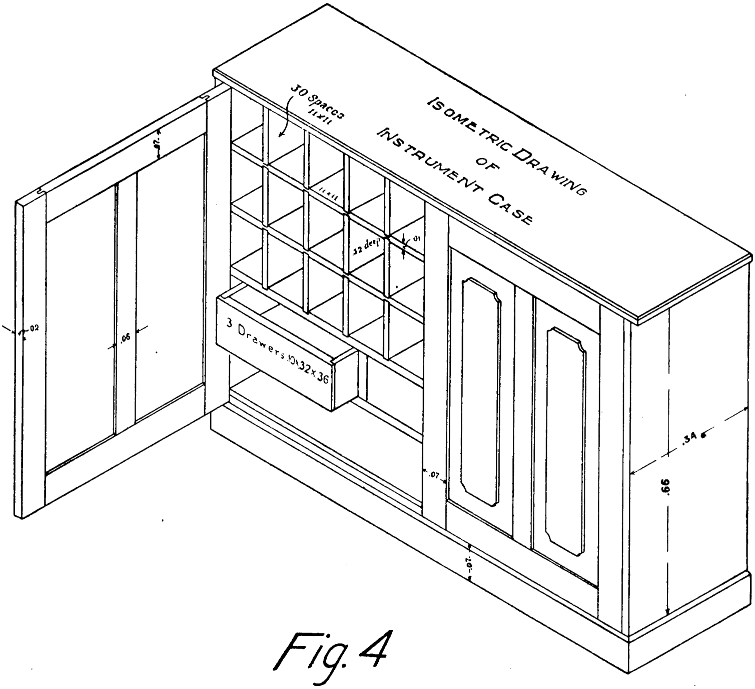


Fig. 4

BILL OF MATERIAL FOR INSTRUMENT CASE (Fig. 4).

[Finished dimensions.]

Part.	Number of pieces.	Thickness.	Width.	Length.
Top	1	0.02	0.36	1.30
Sides	2	.025	.34	.73
Bottom	1	.02	.32	1.20
Shelf	2	.02	.32	1.20
Shelf	2	.01	.32	1.20
Divisions	27	.01	.114	.32
Divisions	4	.02	.03	.10
Door frame	4	.02	.07	.66
Door frame	4	.02	.07	.60
Door frame	2	.02	.06	.58
Panel	4	.015	.22	.54
Drawer	3	.02	.10	.36
Drawer	6	.013	.10	.315
Drawer	3	.01	.35	.315
Drawer	3	.01	.08	.334
Back	1	.012	1.22	.74
Rails	1	.02	.07	1.29
Rails	2	.02	.07	.36
Strip below doors	1	.02	.05	1.20
Supports for lower shelf	3	.02	.07	.328

Accessories: 2 pairs brass hinges, 0.076 by 0.025 (3″ by 1″); 1 Y. & T. cupboard lock; 1 hook and eye, brass, 0.05; 3 flush rings.

One of the necessities of a drawing room is an instrument case of sufficient size to hold all the instruments which are in continual use. The above illustration shows an instrument case which, owing to the arrangement, is appropriate for this purpose. It may be built of tanguili or wood of similar grade, neatly finished, and set upon a table within easy reach of the teacher's desk. The pigeonholes, which are 0.11 by 0.11 by 0.32, can easily accommodate a set of instruments, a 45° and a 30°–60° triangle, a scale, and the necessary pencils. The three drawers may be used for instruments not included in the set, pens, pencils, erasers, penholders, thumb tacks, etc. The open space below may be used for rolls of paper, tracing cloth, blue print paper, etc. All triangles, scales, sets of instruments, etc., should be numbered from 1 to 30. The pigeonholes should be numbered likewise and each set of instruments kept in the correspondingly numbered pigeonhole.

Rear edge of top and sides should be grooved 0.01 to receive the back.

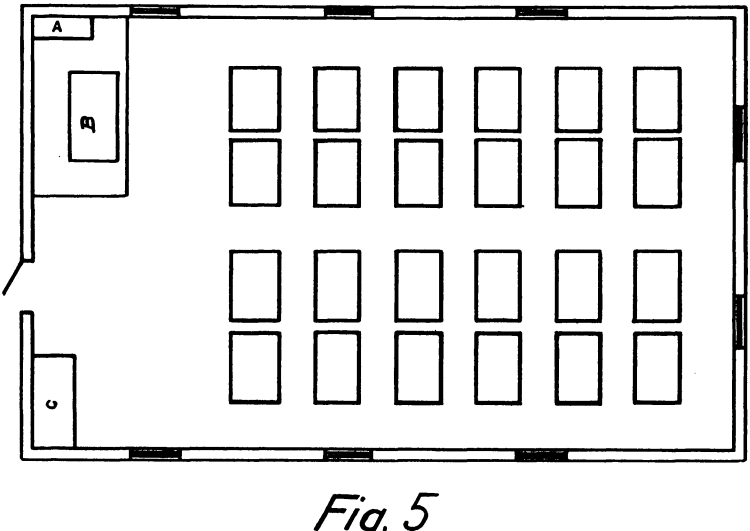


Fig. 5

Plan of a drawing room, showing arrangement of furniture. A, Instrument case. B, Teacher's desk. C, Drawing-board case.

INSTRUMENTS AND SUPPLIES.[1]

The following list of instruments, equipment, and supplies has been compiled on the basis of a trade class of thirty pupils and a manual training class of from sixty to seventy-five pupils. The supplies are sufficient for these classes for a period of three years:

Thirty drawing boards 0.35 by 0.50.
Six drawing boards 0.48 by 0.60.
Thirty T-squares, 0.55 blades.
Six T-squares, 0.65 blades.
Thirty each of 45°, and 30°–60° triangles.
Thirty dividers.
Thirty pencil legs.
Thirty pen legs
Fifteen pens, bow.
Thirty pens, ruling.
Thirty Metric-English rules.
Four transparent protractors.
One pair proportional dividers.
One set irregular curves.
One first-class complete teacher's set of instruments.
One first-class box of colors.
One set of brushes (12 in set).
One thousand thumb tacks (small, silvered steel).
One gross pencils, H.
One gross pencils, HHH.
Two gross pens, Gillott's, No. 303.
Six dozen pencil-and-ink erasers.
Three dozen 1-ounce bottles black waterproof drawing ink.
Two pint bottles black waterproof drawing ink.
Six 1-ounce bottles red waterproof drawing ink.
One-half ream Whatman's Double Elephant, hot pressed, 0.68 by 1.01, or other good drawing paper.
One ream German white, 0.61 by 0.97.
One-half ream manila paper.
One roll tracing cloth.
Two rolls tracing paper.

PENCIL.

The pencil lines should be very light, and clearly visible. The best results have been obtained from a pencil with a chisel-shaped point. Fig. 6 shows two views of the chisel-point pencil.

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[1] Dimensions expressed in meters.

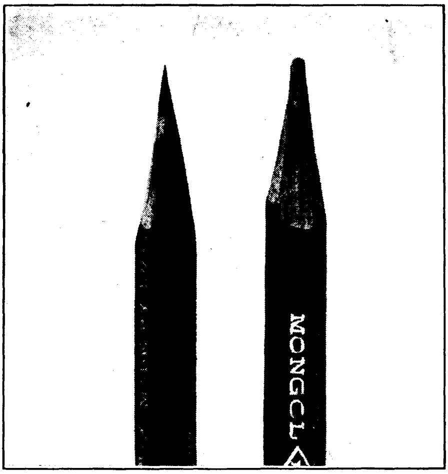

FIG. 6.—Chisel-point pencil.

The marking off of points, lettering, etc., require the use of a round point, but the necessity of using two pencils may be obviated by putting a chisel point on one end and a round point on the other. In using the chisel point, the flat side of the point should be held firmly but lightly against the ruling edge, making a line close to the edge. In this way the best results may be obtained. All horizontal lines should be ruled from left to right, inclining the hand a little toward the right. Note the inclination of the pencil in fig. 7. Vertical lines should be ruled from bottom to top.

DRAWING BOARD.

Each pupil taking the trade course should have a drawing board. This will obviate the necessity of removing the paper from the board at the end of each period. If possible, each pupil of the manual training classes should have a board; but this would require a larger number of boards than can be afforded in some instances. Great care should be exercised in handling the boards, so as not to dent the faces and working edges. When not in use, the drawing board should be placed on end in the case provided for that purpose. This will prevent warping and unnecessary handling. Only the left edge of the drawing board should be used for the head of the T-square.

T-SQUARE.

A T-square must be handled with care, as it is easily put out of adjustment and the blade, which is very thin, is likely to become dented. Always keep the head of the T-square firmly against the left edge of the drawing board. The pupil should become accustomed to *"feel"* the head of the T-square firmly against the drawing board. Note the position of the little finger and thumb at the head of the T-square. With the left hand the T-square can be moved up and down the edge of the board, and *horizontal* lines may be drawn at any point on the paper. When the T-square is not in use, it should be hung from a nail or peg driven into the side of the drawing table. The T-square should be numbered, so that each pupil may always have the use of the same one. In fig. 5 note the arrangement of the drawing tables in double rows. In this manner much space is saved. The T-squares should be hung from the tables on the ends near together, so that they will not be disturbed by pupils passing through the aisles.

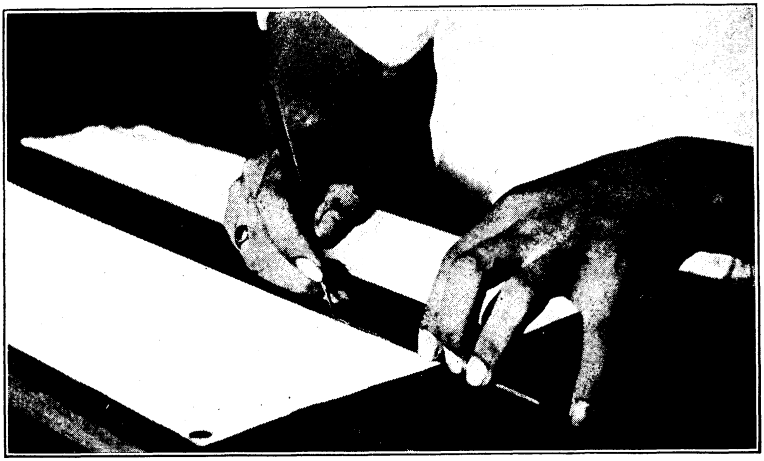

FIG. 7.—Showing the proper position of the fingers of the left hand in holding the head of the T-square.

TRIANGLES.

Each pupil should have the use of a 30°–60° triangle and a 45° triangle. The same care should be taken of the triangles as of the T-squares. Any one of the three edges may be used for ruling purposes. These triangles are used for drawing *vertical* lines, and lines of 30°, 60°, and 45°. In fact, *all straight lines not horizontal must be drawn with the triangles.* The base of the triangles should be held firmly against the top edge of the T-square. In this way the triangle may be slid along the edge of the T-square from left to right or from right to left. When ruling a series of vertical lines, the palm of the left hand should rest firmly upon the blade of the T-square, pressing it toward the right, so that its head will be in perfect contact with the edge of the drawing board; the fingers should rest on the triangle in such a way that it can be moved along the T-square without changing the position of the hand.

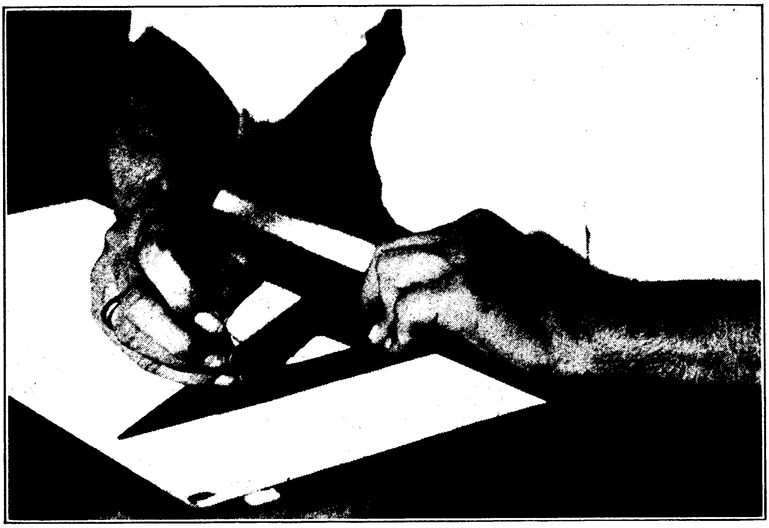

FIG. 8.—The fingers of the left hand may be extended for several inches, carrying the triangle along without changing the position of the hand which holds the T-square in place.

All vertical lines should be drawn using the left edge of the triangle as the ruling edge. (See fig. 8.)

RULING PEN.

Care must be exercised in using the ruling pen, as it is quickly ruined by improper use and careless handling. Before putting the pen away, it must be cleaned thoroughly and the nibs opened. It may be filled by inserting a split and sharpened quill full of ink between the nibs. Putting too much ink in the pen will cause the ink to drop and blot at the least jar. When the pen is used with too little ink, the ink may dry and harden and a poor broken line is the result. Do not press the pen too hard against the ruling edge as too great pressure will cause the nibs to close and make an irregular line. If possible, avoid going over a line, and *never rule backward;* that is, from right to left or from top to bottom. Take great care not to overrun lines at their points of meeting. In fig. 9, it will be noted that the hand holding the pen rests on the tip of the little finger, which slides on the T-square. Always incline the ruling pen in the direction which the line takes. By occasionally rubbing the inside of the nibs with a cloth moistened with oil, a steady flow will be secured. When the points of the nibs become dull,

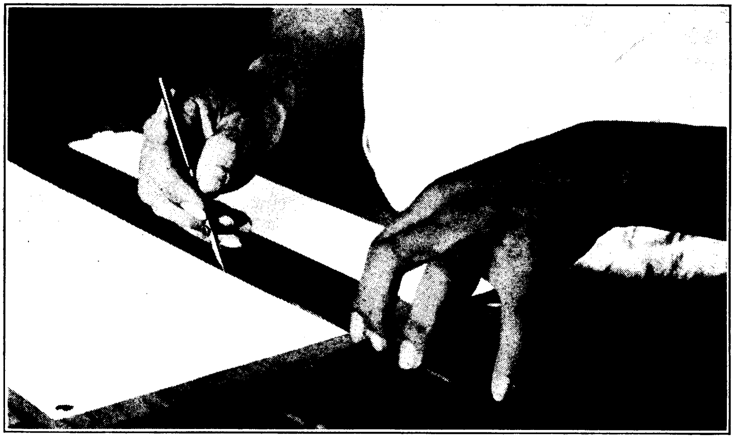

FIG. 9.—Showing the proper way to hold a ruling pen.

they should be sharpened on an oilstone, as otherwise the pen will make broken lines. When the pen is in need of sharpening, first see that the points are even, and, if not, they must be *trued* by rubbing them forward and backward upon the oilstone with the nibs slightly open, until the points become elliptical and of the same length. This will of course dull the points, but they can then be sharpened by rubbing the backs of the nibs upon the stone.

Never rub the inside of the nibs upon the oilstone. The teacher should not permit the pupils to sharpen ruling pens without close supervision, as a good pen may easily be ruined by improper sharpening. *Be sure that the pen is clean before putting it away.*

SCALE AND SCALE DRAWING.

Among the first lessons given to a beginning class should be a thorough discussion of the scale. In laying off measurements from the scale to the paper, the round-point pencil *only* should be used. The scale should be placed *close* to the line. Never do any ruling with the scale. All measurements should be made entirely in the *metric system,* and should be expressed in meters or decimal parts of a meter.

In many instances the object to be drawn is much larger than the paper and therefore can not be contained within the limits of the paper. This necessitates the use of a scale drawing of a *reduced size;* that is, 0.01 m. in the drawing represents more than 0.01 in the object. If the drawing be marked thus: Scale 1: 2 m., it is one-half the size of the object. Some common scales are as follows: Shop exercises, 1:2; drawing tables, 1:10; wardrobes, 1:20; buildings, 1:100; maps of school grounds, 1:200 or 1:500.

In some instances the object may be small, and it would be convenient to make the drawing larger than the object. This would necessitate the use of a scale drawing of an enlarged size; that is, 0.01 m. in the drawing represents less than 0.01 in the object. If, for example, 0.02 m. in the drawing represents 0.01 in the object, then the drawing must be marked thus: Scale 2:1 m. This means that the drawing is 2 times the size of the object. This scale is seldom used in school work; however, it is used in making detailed drawings of very small tools and instruments.

COMPASSES.

The compasses should be supplied with a pen and pencil leg. In using either one or the other, the tip should be even with the needle-point when the compasses are closed. The needle-point with a shoulder is recommended when several circles or arcs are being made with a common center; because by using the tapering needle-point several times in the same center, a large hole will be made in the paper. To adjust the compasses, first place the pen leg in the socket provided for its reception and then set the tip of the needle-point of the other leg even with the tip of the pen. When the pencil leg is attached, the needle should not be moved; but the lead in the pencil leg may be set even with the needle-point. In using the compasses, hold the head (or handle, if they have one), loosely between the thumb and the first two fingers, and twirl the compasses slowly to the right. In using the pen leg *set the needle-point first* and then allow the pen point to touch the paper. A circumference or an arc should always be inked with one movement. In inking a circle stop the pen at the starting point. Otherwise an uneven line may be produced by going over the same line.

Always lean the compasses a little in the direction taken by the line, as this will facilitate the drawing of the circle or arc. (See fig. 10.) The bow-pen or small inking compasses should always be used for small circles. The pen leg and the pen of the bow compasses should be cleaned and treated as carefully as the ruling pen, as they really are ruling pens used for special purposes. The legs of the compasses may sometimes become loose. A key is always supplied for the purpose of tightening them. When working with the compasses, the legs should be bent so that they are perpendicular to the paper.

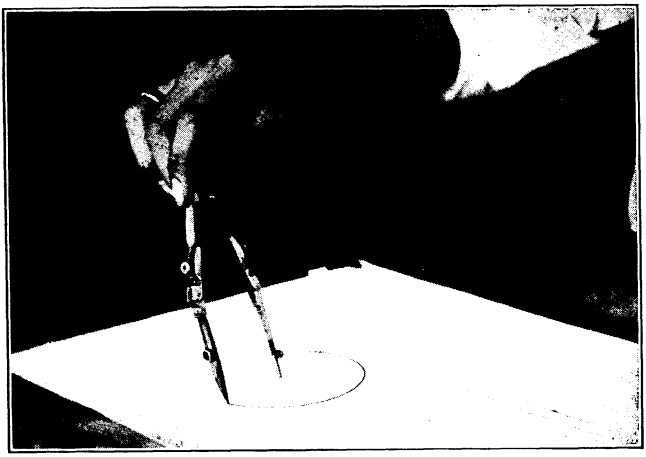

FIG. 10.

LETTERING AND LINES.

A neat drawing may easily be spoiled by poor lettering. Every pupil should learn to letter well. *Only the plain Gothic vertical and slant, upper and lower cases,* should be used. A sample of each is shown in fig. 20 A, Part II.[1] All lettering should be free-hand and should read from left to right for horizontal lines and from bottom to top for vertical lines. Figures are to be read in the same manner.

All lines on a drawing should mean something; and it is essential that their use throughout our schools be uniform. See fig. 11 for standard lines. The following-described ink lines will be used throughout these courses. The *invisible*

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[1] Plate 3, Courses in Mechanical Drawing.

lines of an object are shown by short dashes of the same thickness as the other lines in the drawing as shown by line 2 of fig. 11. *Dimension lines* are to be drawn in red ink only on a tracing, and are to be terminated by arrowheads in black ink. Where dimension lines are drawn in black ink, they should be in long dashes. It is advisable to get accustomed to inking the top and left-hand lines first and then the lower and right-hand lines, as much time can be saved in this way. When inking in a drawing in orthographic projection, *make all the right and lower lines heavy and the left and upper lines light.*[1] In placing the dimension numbers, only the decimal part of a meter should be used; for example, 0.01, not 1 cm.; 0.1, not 1 dm.; 0.001, not 1 mm.[2] Construction or projection lines should be shown by short light dashes. The only difference between the invisible and the construction line is that the former is as heavy as the other lines in the drawing, while the construction line is lighter. Always remember that the neatness of a drawing depends largely upon the carefulness and accuracy of the work.

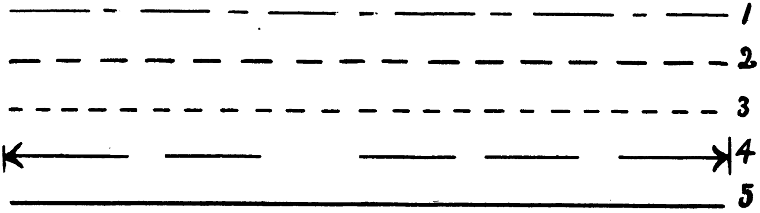

Fig 11

Standard lines: 1, center line; 2, invisible line; 3, construction line; 4, dimension line; 5, visible line.

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[1] For exceptions see figs. 15 and 16.

[2] See "Scale and Scale Drawings."

TRACING.

Either side of the tracing cloth may be used. If pencil lines are used, they can more readily be erased from the glazed side. Tracings may be made directly from a pencil drawing. Before beginning to ink on the tracing cloth, spread some powdered chalk on the surface and rub it in with a soft piece of cloth or with a blackboard eraser. This process will dull the glaze and allow the cloth to take ink more readily. In order to make the blue print clear, the ink lines on a tracing should be somewhat heavier than on drawing paper. If possible, avoid erasing; but if positively necessary, a sharp knife or a rubber ink eraser should be used. Never fold a tracing, as the crease will make a line which, on the blue print, may be mistaken for a drawn line. If tracings are to be preserved, they should be rolled up. In handling tracing cloth avoid all wrinkling, as wrinkles will show on the blue print. Ink dries very slowly on tracing cloth; therefore care should be taken to avoid rubbing the T-square or triangle over a wet line. For practice work in tracing, tracing paper should be used, as it is much cheaper than tracing cloth.

SYSTEMS OF DRAWING.

ORTHOGRAPHIC PROJECTION.

Orthographic projection is a system for the correct representation of objects by means of drawings. This system consists of projecting from a plan into an elevation, or from an elevation into a plan, the lines of projection in a set being parallel and the respective sets of lines being at right angles to each other. Details of objects as they actually exist are represented to scale. Most working drawings (for examples, see figs. 22, 31, and 32) are drawn in orthographic projection. Ink lines and shade lines as described under "Lettering and Lines" apply to this system of drawing.

ISOMETRIC DRAWING.

This is a system of drawing based upon a cube so situated that three of its sides are equally represented; hence the name, "Isometric drawing," meaning equally represented. By examining fig. 12 it will be seen that the cube has three sides equally shown; the lower lines are drawn at an angle of 30° with the horizontal; the line in front is drawn perpendicular to the horizontal; and all other lines are drawn parallel to these lines and are of the same length as the corresponding lines in the object itself.

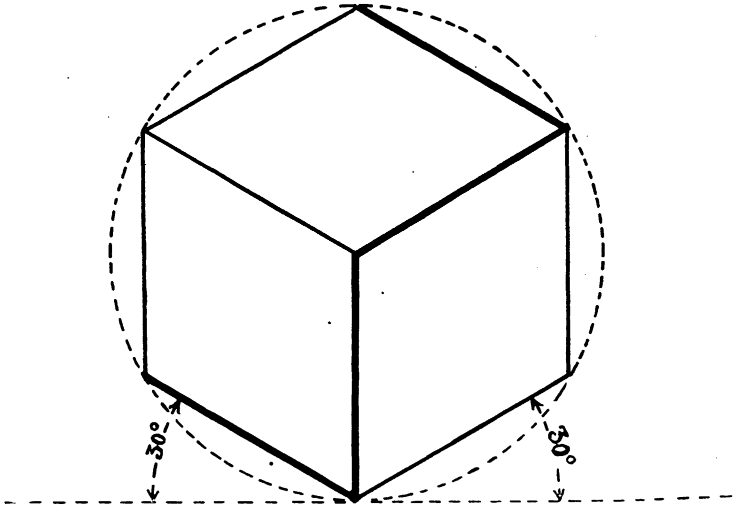

Fig. 12

The ordinary scale may be used in this system of drawing. However, it must be remembered that drawings made in this manner are not geometrically correct, although they serve as excellent examples for illustrative purposes. It is very convenient to represent wood joints, furniture, and details by isometrical drawing.

MECHANICAL SKETCHING.

A mechanical sketch is a representation in free-hand of a mechanical drawing; therefore the teacher must thoroughly familiarize himself with the subject of mechanical drawing before attempting to give any instruction in sketching.

Particular attention should be given to orthographic projection. When referring to drawings in sketching, the same technical terms are used as in mechanical drawing.

One mistake frequently made in sketching is that of making the sketches too small; if made too small, details can not be properly represented. A sketch should be made approximately the same size as a mechanical drawing of the object would be made.

Models for sketching should be obtained from the shops. The sketching for ironworking pupils will be mainly in ironwork; woodworkers will sketch objects mainly of woodwork. Mechanical sketching and mechanical drawing will be correlated throughout the course. The pupil should always make a free-hand sketch, which should be used as a guide in making a mechanical drawing. An illustrative sketch is shown in fig. 21. The mechanical drawing reproduced from this sketch is shown in fig. 22.

DETAILED AND ASSEMBLED DRAWINGS.

Mechanical drawing may be divided into two classes: detailed drawings and assembled drawings. A detailed drawing is one in which the parts of an object are shown separated or taken apart. A drawing showing a bench vise in which parts are separated and shown piece by piece with all necessary dimensions constitutes a detailed drawing. An assembled drawing would show the bench vise with the pieces placed together to form the whole, as when the vise is in use in the shops. Such a drawing is sometimes called an "assembly." In an "assembly," only the most important dimensions need be shown.

ESSENTIAL DEFINITIONS.

Before the pupil can learn to handle the various instruments intelligently, he must know the meaning of the simple technical terms used in mechanical drawing, so that the teacher in giving instructions to his class will not have to stop to explain their meaning. Definitions of the following terms[1] should be taken up by the teacher for discussion immediately after the opening of school in June. Each definition should be given clearly and illustrated on the blackboard:

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[1] For explanation of these terms, see Appendix.

1. Straight line.
2. Curved line.
3. Horizontal line.
4. Vertical line.
5. Slanting or oblique line.
6. Parallel lines.
7. Perpendicular line.
8. Intersecting lines.
9. Intersection.
10. Angle and degree.
11. Acute angle.
12. Obtuse angle.
13. Right angle.
14. Angle of 45°.
15. Angle of 30°.
16. Angle of 60°.
17. Circumference, circle.
18. Diameter, radius.
19. Triangle.
20. Margin.
21. Margin line.

When the above terms are clearly understood by the entire class, the teacher should take up the use of the drawing board, T-square, and triangles, as already explained in this chapter. As the pupils advance, the various instruments and their uses should be discussed with the whole class. By closely following the instructions laid down in these notes, the work will be facilitated and the progress will be more rapid and uniform throughout the Islands.

SHADE LINES.

From the pictorial point of view, mechanical drawings are improved by the use of proper shade lines; these are heavy lines placed in the drawing on the edges which separate light surfaces from dark surfaces, assuming the light to be falling from the left upon the drawing at an angle of 45°. This is the general rule.

By examining figs. 13 and 14, which represent blocks with a projection upon the surface of each, it will be seen that the lower and the right-hand edges of the projections are shaded; and by examining figs. 15 and 16, which represent blocks with a hole cut through each, it will be seen that the upper and left hand sides of the holes are shaded. These may be taken as general rules for shading. The following figures will serve to explain shading in orthographic projection.

For shade lines in isometric drawings, examine figs. 33 to 42 inclusive.

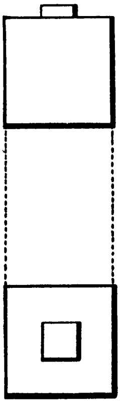

Fig. 13

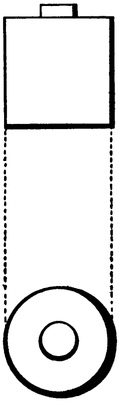

Fig. 14

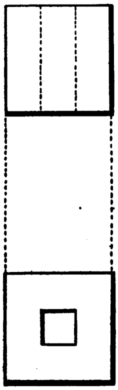

Fig. 15

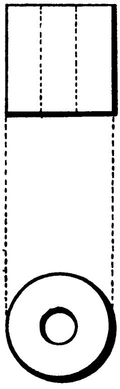

Fig. 16

PART II.

COURSE OF STUDY FOR TRADE SCHOOLS AND MANUAL TRAINING CLASSES.

[NOTE.—**Measurements expressed in decimal parts of a meter, in accordance with Act No. 1519.**

This chapter consists of time schedules allowed for each course and suggestive plates with notes. Two parallel courses are given for pupils taking trade courses, one being intended for woodworkers (W. W.), and the other for ironworkers (I. W.).

Notes and suggestions are given wherever helpful. Each completed plate has a margin of 0.05 on the left side. In this margin there should be two small holes to permit the insertion of a cord or clip to bind the plates together. A good cover may be made of manila paper.

SCHEDULE FOR TRADE CLASSES.

Year.	Semester.	Plates.	Time (hours).
First	1	1 to 18, inclusive	132
	2	19 to 25, inclusive	129
Second	1	26 to 33, inclusive	78
	2	34 to 42, inclusive	79
Third	1	43 to 45, inclusive	52
	2	46 A, B, C	52

SCHEDULE FOR MANUAL TRAINING CLASSES.

Grade.	Semester.	Plates.	Time[a] (hours).
V	1	1 to 6, inclusive	43
	2	7 to 13, inclusive	48
VI	1	14 to 18 A, B, C, D, E	45
	2	19 to 22, inclusive	46
VII	1	23 and 24	44
	2	25 A, B, C, etc	47

[a] Approximate.

LAYING OUT THE PLATE.

With the scale, determine a point approximately on the vertical center between the left and right edges of the paper. Measure 0.015 to the right and draw a light vertical line through this point; this will be the vertical center of the plate. With the scale, find the middle point between the upper and lower edges of the paper. Through this point draw a light horizontal line.

From the intersection of the two center lines measure 0.20 to the right and 0.23 to the left on the horizontal center line; mark the points, and through these points draw vertical lines. These will be the outer vertical lines of the margin. Five centimeters from the left margin line, draw the inner vertical margin line. From the intersection of the center lines measure 0.14 upward and downward, respectively. Through the points determined, draw the outer horizontal margin lines. Now draw the other three inner margin lines 0.02 from the outer lines.

A rectangle 0.24 by 0.36 will now be inclosed by the margin. Within this rectangle the drawings are to be made. Instructions must be followed closely, as there should be a uniform plate throughout the course.

Throughout the drawing course articles will be drawn which will necessitate the use of a larger sheet of paper than that above described. For such articles, a plate is recommended which, when folded, will be the exact size of the plate described above. Fig. 17 shows the size of plate to be used. The plate can be folded along the dotted line and be bound in book form by the pupil at the end of the year.

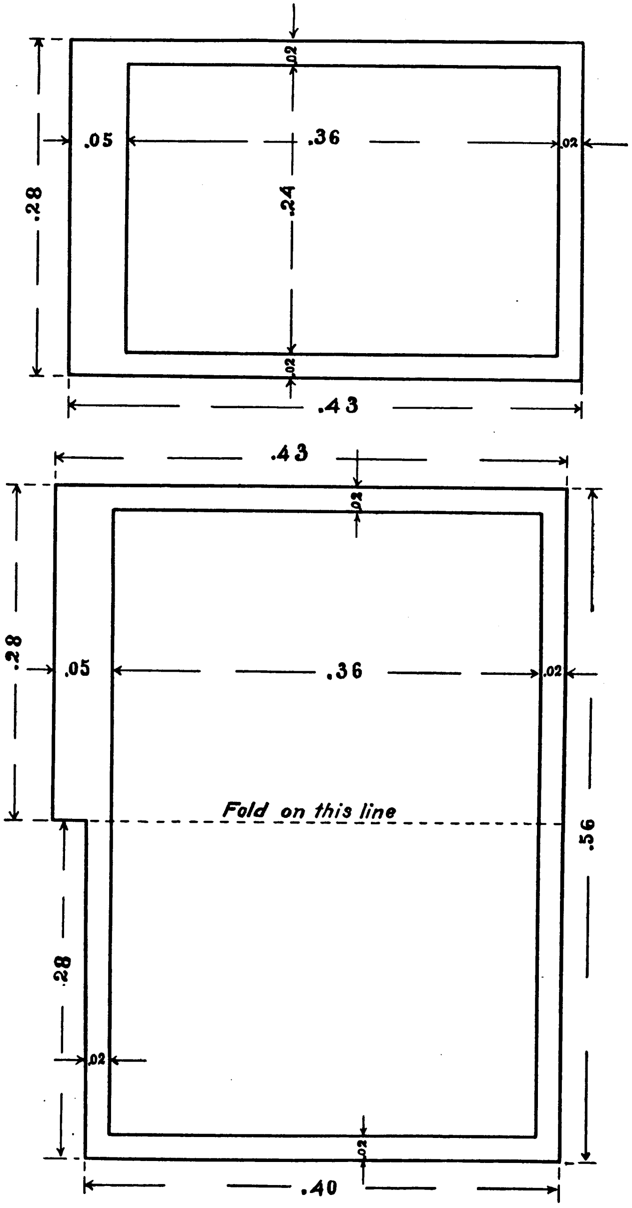

Fig. 17

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OUTLINE OF WORK.

FIRST YEAR TRADE COURSE, AND MANUAL TRAINING COURSE COMPLETE.

PLATE 1 (8 hours).—*Practice exercise in ruling straight lines.*

In each corner of the plate lay off squares 0.115 by 0.115; then lay off two more squares of the same dimensions on the vertical center line. Beginning at the upper left-hand corner of the plate, space and rule the squares as shown in fig. 18. The distance between lines in spacing will be 0.005 except in the lower central square, which is to be ruled, as in shading, by gradually increasing the spaces between lines, judging with the eye and using no measurements in spacing. Ink the plate.

PLATE 2 (10 hours).—*Practice plate.*

This is a practice plate in ruling, drawing circles, and inking. The plate should be carefully spaced. If the pupils do not have books, the teacher should make a large illustrative drawing of the plate upon the blackboard, from which the pupils may make their copies. Ink the plate. (Fig. 19.)

PLATE 3 (12 hours).—*Free-hand lettering.*

The upper and lower cases of two styles of free-hand Gothic are shown, with Arabic numerals to correspond to each case. The letters should be drawn in ink with a No. 303 Gillott's pen. The pupil should be taught to make each line in a letter with a single stroke of the pen. Small letters should be two-thirds the height of the capitals. (Fig. 20 A.)

PLATE 4 (4 hours).

W. W.—An exercise in chiseling (fig. 22).

I. W.—A bench block (fig. 29). An exercise in squaring a piece of iron (fig. 28).

These exercises are to be drawn full size in orthographic projection, showing a plan and two elevations of each.

Ink the plate, using proper shade lines. The pupil should be required to make the mechanical drawings from sketches and not directly from the models.

PLATE 5 A (5 hours).

W. W.—An end lap joint (fig. 33); a through mortise-and-tenon joint (fig. 34).

I. W.—Two styles of angle irons (figs. 23 and 27).

Draw in orthographic projection, showing the plan and two elevations ef each. Scale 1:1.

PLATE 5 B. (Optional.)

W. W. and I. W.—Make an isometric drawing of the objects drawn on Plate 5 A and then carefully ink the drawings using shade lines. For proper use of shade lines, examine isometric drawings in this text.

PLATE 6 (4 hours).

W. W.—A lap butt joint (fig. 42); a corner mortise-and-tenon joint (fig. 35).

I. W.—A "T" weld (fig. 24); a try square (fig. 26).

Make drawings of these objects showing the plan and two elevations of each in orthographic projection. Scale 1:1.

NOTE.—All succeeding plates will be made in orthographic projection unless otherwise specified.

PLATE 7 A (4 hours).

W. W.—A dovetail joint (fig. 40); a panel joint or door joint (fig. 36). Scale 1:2.

Optional exercises.—Figs. 38 and 41.

I. W.—An exercise in filing a dovetail (fig. 25); an exercise in filing a sliding fit (fig. 30). Scale 1:1.

PLATE 7 B. (Optional.)

W. W. and I. W.—Make an isometric drawing of each object drawn on Plate 7 A. Ink the plate.

PLATE 8 (6 hours).

W. W.—Make drawings of paper files with square, pentagonal, and octagonal bases, respectively. Base will have suitable wire in center about 0.10 high for holding paper. Show plan and one elevation. Scale 1:1. (Fig. 32.)

I. W.—Make a drawing of a square nut (fig. 46); make a drawing of a hexagonal nut (fig. 47). Scale 1:1. Show plan and one elevation of each.

PLATE 9 (4 hours).

W. W.—Draw a plan and two elevations of a drawing board. Draw two elevations of a 45° triangle. Draw two elevations of a 30° by 60° triangle. Draw a plan and an elevation of a T-square. Make these drawings to a suitable scale. Use the dimensions shown in figs. 64, 65, 66, and 67 in this manual.

I. W.—Make drawings of the following: Chain links (fig. 61); ring (fig. 62); hasp and staple (figs. 59 and 60). Scale 1:1.

PLATE 10 (5 hours).

W. W.—Make a drawing showing a plan, an elevation, and a cross section of an inkstand. This stand should be designed to hold the bottle of drawing ink. (See fig. 31.[1]) Scale 1:1.

I. W.—Draw a plan, an elevation, and a cross section of a blacksmith's hammer (fig. 51). Scale 1:1.

PLATE 11 (5 hours).

W. W. and I. W.—Draw a plan and two elevations of a small box to convenient scale. The teacher may sketch a box upon the blackboard and require the pupils to make the mechanical drawing from this sketch.

NOTE.—Manual training pupils will substitute here Plate 28. (8 hours.)

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[1] It may be necessary to adapt this design to the style of bottle used.

PLATE 12 (15 hours).

W. W. and I. W.—Draw a plan and two elevations of a chest or locker to convenient scale. Pupils in the woodworking class may prepare a box suitable for carpenter's tools and pupils in the ironworking class may prepare a box suitable for blacksmith's tools. If a box for tools is not needed, the pupil may prepare drawings for a clothes chest or locker. The teacher should prepare sketches, from which the pupil can make his drawing.

PLATE 13 (6 hours).

W. W.—Make a drawing showing a plan and two elevations of a mallet (fig. 55). Scale 1:2.

I. W.—Draw two elevations of a hexagonal cold chisel and a punch (figs. 57 and 58). Scale 1:1.

NOTE.—The cutting angle of the chisel should measure 60°.

PLATE 14 (6 hours).

W. W. and I. W.—Make a drawing of some object to be made in the shop. The selection of this object will be determined by the teacher.

PLATE 15 (5 hours).

W. W. and I. W.—Make a complete drawing of a bolt and nut, showing the threads by the accurate method. Draw a cross section of the nut. Make a second drawing of the bolt and nut, showing threads by conventional method. (See Appendix.)

PLATE 16 (3 hours).

W. W.—Make drawings of wood-turning exercises: A darning ball (fig. 56); a baluster (fig. 53); chisel handle (fig. 54).

I. W.—Make drawings of a ball peen hammer (fig. 50); make drawings of a pair of tongs (fig. 63).

PLATE 17 (4 hours).

W. W.—Design a halved splice from specifications as follows: Material, 0.05 by 0.05 square on ends; length of splice, 0.10; total length of finished piece, 0.20. Scale 1:1.

Design a through mortise-and-tenon joint, material 0.03 by 0.05 on ends; length of mortised piece, 0.12; total length of tenoned piece, 0.17; mortise, 0.01 by 0.05. Scale 1:1.

I. W.—Design a cold chisel to be made of hexagonal steel 0.02 in diameter across the corners. Flattened portion to be 0.023 wide at the tip and to extend back a distance of 0.08. The tip will have a cutting angle of 60°. Head of chisel to be flat on end 0.015 in diameter and to slope forward for a distance of 0.015. Shank to be of suitable length.

Design a punch to be made of round bar steel 0.009 in diameter; point to be tapered to a diameter of 0.003; length of taper, 0.037; head to be tapered to a diameter of 0.006, extending forward a distance of 0.012. Scale 1:1. Shank to be of suitable length.

PLATE 18 A (6 hours).

W. W.—Design a book shelf. Pupil prepare original sketch.

NOTE.—This design should be very simple.

I. W.—Make a drawing of a pair of parallel clamps (fig. 43).

PLATE 18 B, C, D, E, ETC. (20 hours).

These plates will consist of drawings of exercises which are to be made in the shops and for trade pupils will continue until the close of the first semester.

Considerable time will have been spent in class instruction; the total amount of time allowed for drawing plates 18 B, C, D, E, etc., and for class instruction will be 20 hours.

NOTE.—Manual training pupils will take the above plates, and more if possible. (Time, 21 hours.)

PLATE 19 (6 hours).

W. W.—Make a drawing of an elliptical picture frame to suitable dimensions. (See Prob. 13, Geometrical Problems.)

I. W.—Draw a common wrench (fig. 48); draw an "S" wrench (fig. 44).

PLATE 20 (20 hours).

W. W.—Draw two elevations of the "X" frame drawing table, to convenient scale (fig. 1). Ink or trace.

NOTE.—A plan in this drawing is unnecessary.

I. W.—Draw a plan and two elevations of a work bench for the shop.

NOTE.—Manual training pupils substitute a table and chair.

PLATE 21 A (6 hours).

W. W.—Draw a taboret to convenient scale.

I. W.—Make a drawing of a pair of dividers (fig. 45).

PLATE 21 B (4 hours).

W. W. and I. W.—Trace Plate 21 A.

NOTE.—Manual training pupils make drawing of small bench to be used as a seat.

PLATE 22 (18 hours).

W. W.—Make a drawing to convenient scale of a school desk complete (fig. 172). A plan is unnecessary. Trace this drawing.

I. W.—Make complete drawings for a tool rack for the blacksmith shop.

NOTE.—Manual training pupils substitute Plate 24 (10 hours).

PLATE 23 (18 hours).

W. W.—Make drawings to convenient scale of a front desk and a rear desk (figs. 173 and 174). A plan is unnecessary. Trace this drawing.

I. W.—Make a drawing of an iron fence.

NOTE.—If there is no iron fence near, teacher will prepare sketch, from which the pupil can make his own sketch.

NOTE.—Manual training pupils take Plate 26. (25 hours.)

PLATE 24 (10 hours).

W. W.—Make drawings to convenient scale, of a bed (Spanish style). (See Appendix.) Trace the drawings.

NOTE.—A square post may be drawn, if so desired.

I. W.—Make a drawing of an iron bed. (See Appendix.)

NOTE.—Manual training pupils make drawings of an office desk. (19 hours.)

PLATES 25 A, B, C, ETC.

W. W. and I. W. drawings of shop exercises.—The teachers should select such models from the shops as are to be made by the pupils. Considerable time during this semester will have been spent in class instruction. The total amount of time allowed for drawing Plates 25 A, B, C, etc., and for class instruction, will be 47 hours.

TRADE COURSE, SECOND YEAR.

[Time, three ninety-minute periods per week.]

FIRST SEMESTER.

PLATE 26 (25 hours).

W. W. and I. W.—Mechanical lettering. Letter both the upper and the lower cases of the Plain Block and the Antique Egyptian alphabets. Also make the Arabic numerals which correspond to each case. Ink the plate.

NOTE.—See Plate 20 B. Upon the plate are shown guide lines, which should be drawn in pencil. Outline the letters and numerals with the ruling pen, and fill in with a small brush or a stub pen. After the filling in has been completed, the pencil lines between the letters and figures may be erased. Small letters should be two-thirds the height of the capitals.

PLATE 27 (6 hours).

W. W.—Design a carpenter's sawhorse or trestle. Teacher will offer suggestions.

I. W.—Design a hook and staple for a door.

PLATE 28 (8 hours).

W. W.—Design a bookcase or wardrobe to be made of material 0.022 thick, to have a panel or glass door. Thickness of panel, 0.011 (fig. 183).

I. W.—Design a door hinge or gate hinge.

PLATE 29 (8 hours).

W. W. and I. W.—Design a small tool box suitable for carrying tools about in the shop.

PLATE 30 (10 hours).

W. W.—Design a piece of furniture.

I. W.—Make a complete drawing of the screw and castings in the common wood bench vise. (Not the rapid-acting vise.)

PLATE 31 (8 hours).

W. W. and I. W.—Design a printing frame suitable for the size of the tracings which the pupil has made. (See Appendix.)

PLATE 32.

W. W.—Make drawings of a table (6 hours).

I. W.—Make drawings of a brick or concrete forge. Show plan and two elevations. (See Appendix.) (7 hours.)

PLATE 33.

W. W.—Make drawings of a settee. (See Appendix.) (7 hours.)

I. W.—Make a drawing showing a complete cross section of the forge drawn on Plate 32 (6 hours).

NOTE.—This will close the work of the first semester for second-year trade pupils.

SECOND SEMESTER.

PLATE 34 (3 hours).

W. W.—Make a design of a common bench suitable for a seat or for holding boxes, water pails, etc.

I. W.—Design or draw a pair of blacksmith's pincers.

PLATE 35 (6 hours).

W. W.—Make drawings of a chair.

I. W.—Make drawings of a pair of calipers for use with the wood turner's set of tools.

PLATE 36 (10 hours).

W. W.—Make drawings of a food safe. This safe should have doors made of sheet metal or wire screen.

I. W.—Make a detailed drawing of an iron bench vise.

NOTE.—The vise should be taken apart and each piece sketched, showing all necessary details and dimensions.[1]

PLATE 37 (8 hours).

W. W.—Make drawings of a cupboard.

I. W.—Make an assembled drawing of the vise drawn on Plate 36.[1]

PLATE 38, A, B, C. (OPTIONAL.) (9 hours.)

W. W.—Parallel bars, swinging rings and posts, horizontal bars, hurdles, vaulting standards.

I. W.—Iron settee with wooden slats. (See Appendix.)

PLATE 39 (4 hours).

W. W.—Design a set of porch steps.

Suggestion.—The steps may be made entirely of wood and have a suitable railing at the side.

I. W.—Design window grating with scroll work.

PLATE 40 (6 hours).

W. W.—Make drawings of a door. Select a good modern style of door for a house (figs. 70 and 71 B).

I. W.—Continue Plate 39.

PLATE 41 (8 hours).

W. W.—Make drawings of a shell window (figs. 70 and 71 B).

I. W.—Complete Plate 39.

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[1] See "Detailed and Assembled Drawings," Part I.

PLATE 42, A, B, C (25 hours).

W. W.—Make drawings of an office desk. (See Appendix.)

NOTE.—The drawing of the desk should be completed in detail and may require several plates.

I. W.—Make drawings of a wood lathe. Show details of head stock and tail stock.

TRADE COURSE, THIRD YEAR.

[Time, two ninety-minute periods per week.]

FIRST SEMESTER.

PLATE 43 (10 hours).

W. W.—Design a writing desk.
I. W.—Design an iron gate.

PLATE 44 (8 hours).

W. W.—Design a door or window.
I. W.—Design an iron fence.

PLATE 45, A, B, ETC. (34 hours).

W. W.—These plates will consist of drawings made from a building located near the school, or of drawings of the school building itself. The class should be divided into sections: the first section may draw the plan; the second, the elevation; the third, the details; the fourth, the plan of the floor framing; the fifth, the plan of the roof framing; and the sixth the elevation of the wall framing.

The purpose in dividing the class and having the various sections at work on all parts of the drawing at the same time is to complete the drawings in the time allowed, as it is improbable that any pupil working alone can complete all of this work.

I. W.—Following the same methods as suggested for woodworkers, require the ironworkers to make drawings of a blacksmith shop, or a building suitable for general ironworking purposes.

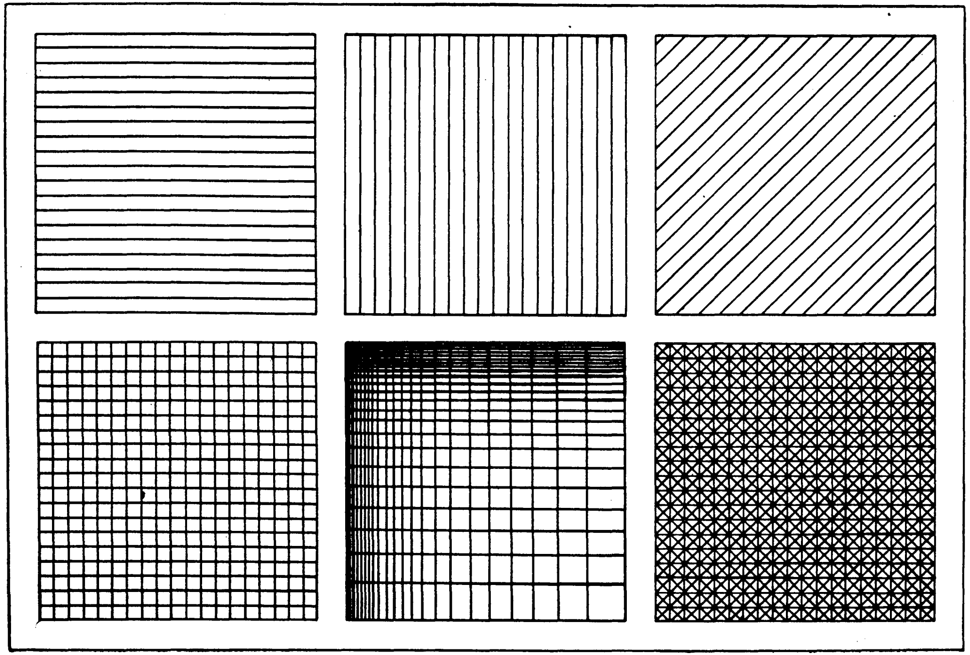


Fig. 18

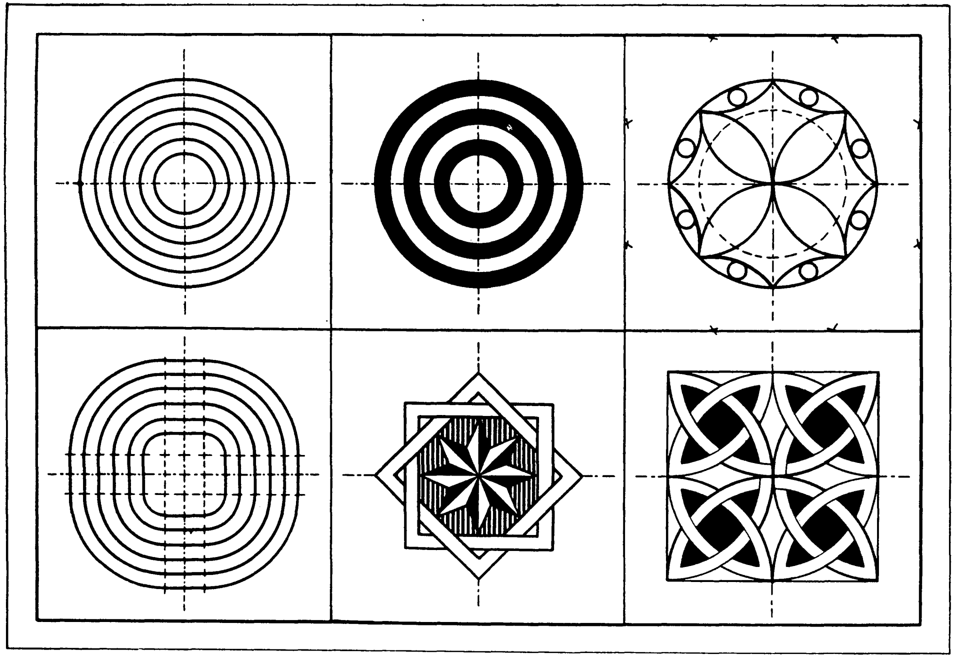
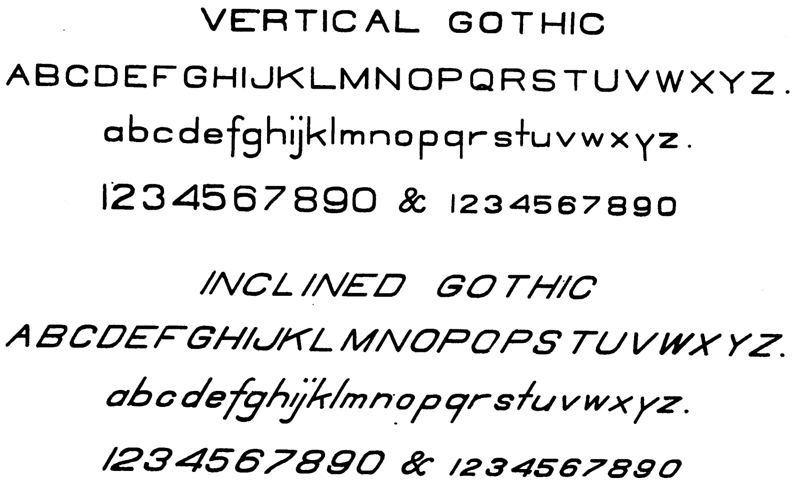


Fig. 19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abcdefghijklmnopqrstuvwxyz.
1234567890 & 1234567890
INCLINED GOTHIC
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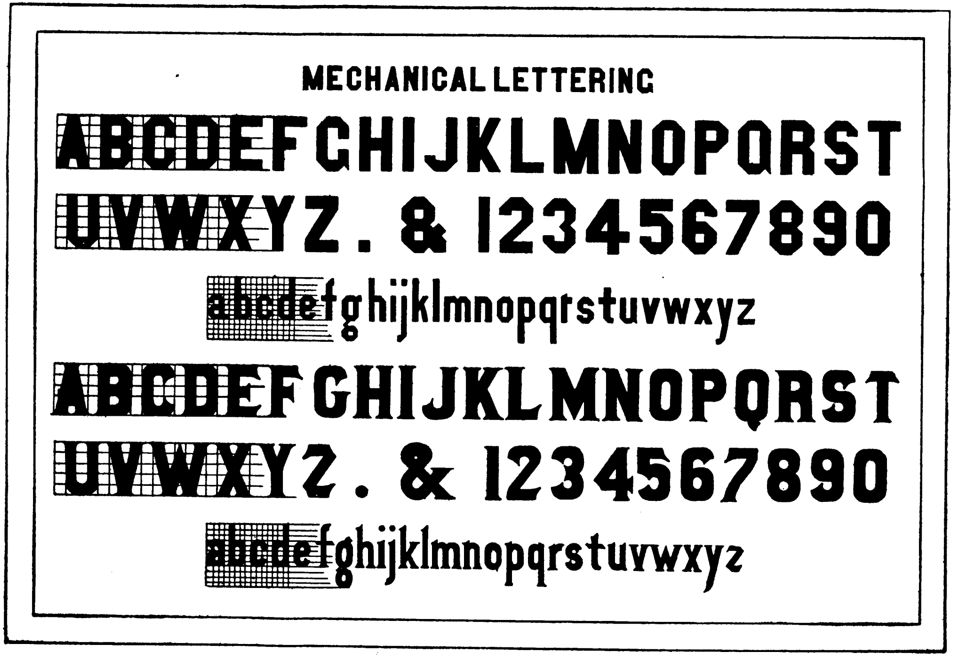
abcdefghijklmnopqrstuvwxyz.
1234567890 & 1234567890

Fig. 20-A


MECHANICAL LETTERING
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UVWXYZ. & 1234567890
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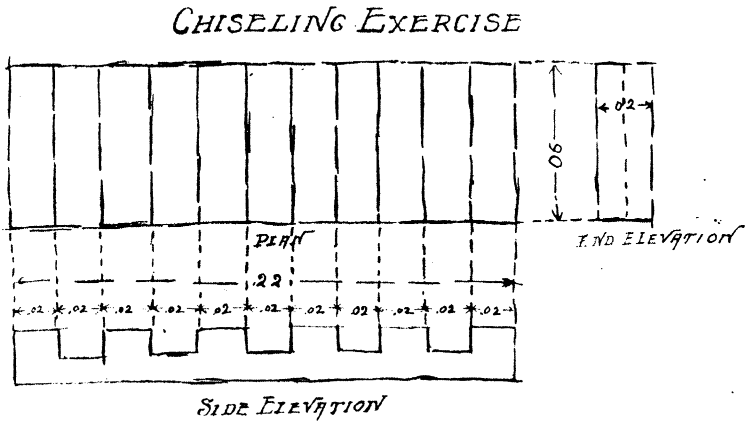
ABCDEFGHIJKLMNOPQRST
UVWXYZ. & 1234567890
abcdefghijklmnopqrstuvwxyz

Fig. 20 B


CHISELING EXERCISE
.06
.02
PLAN
END ELEVATION
.22
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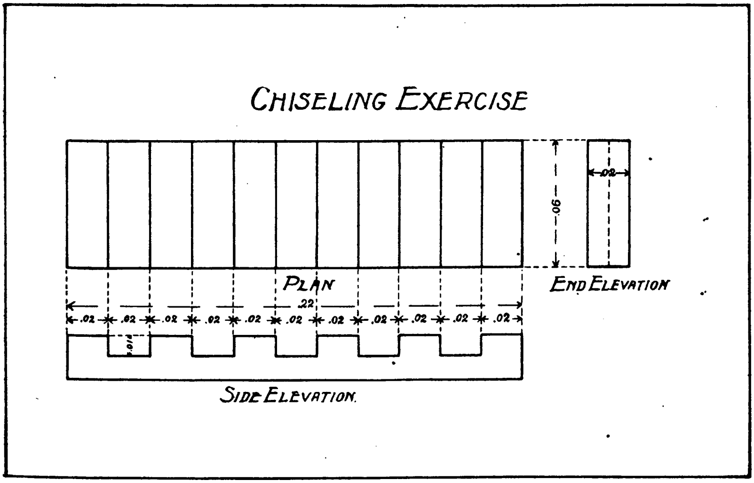
SIDE ELEVATION

Fig. 21


CHISELING EXERCISE
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SIDE ELEVATION.

Fig. 22

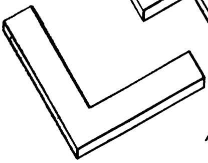
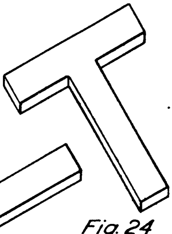


Fig. 23



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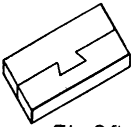

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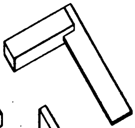


Fig. 26

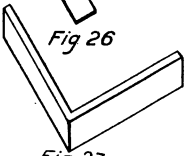


Fig. 27

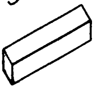
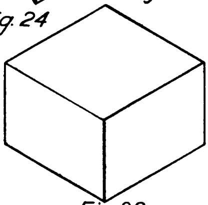


Fig. 28



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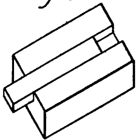
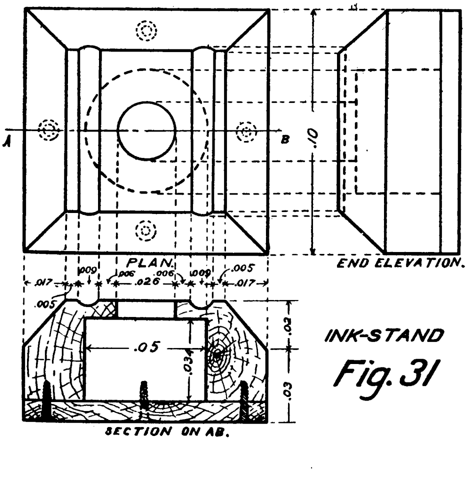


Fig. 30



INK-STAND

Fig. 31

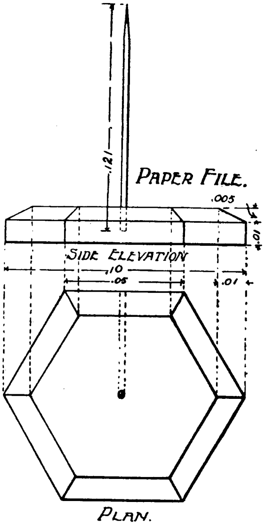


Fig. 32

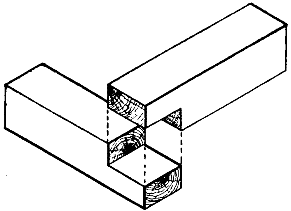


Fig. 33

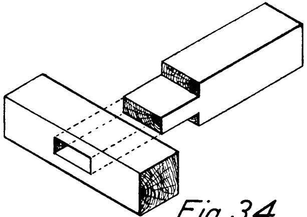


Fig. 34

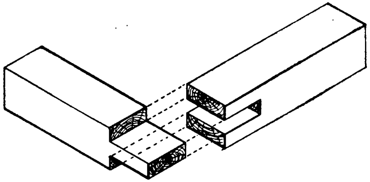
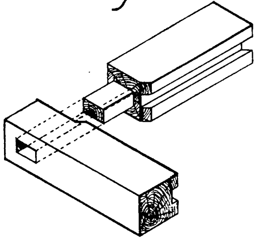


Fig. 35



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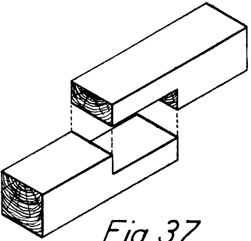

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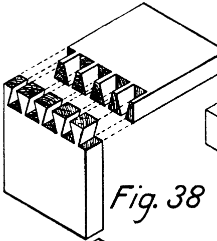

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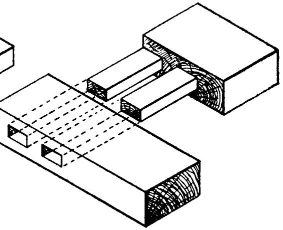

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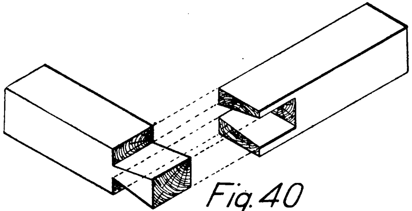

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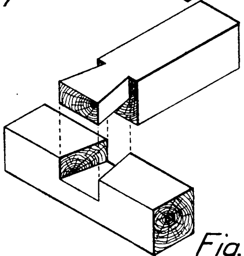

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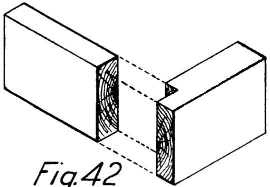

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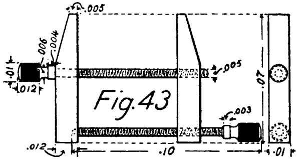

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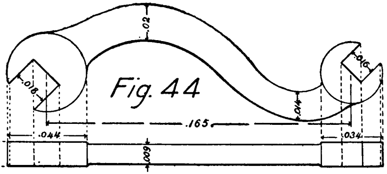

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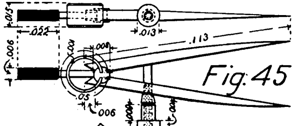

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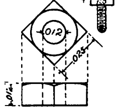

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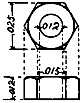

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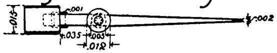

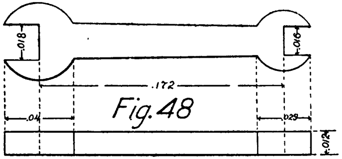

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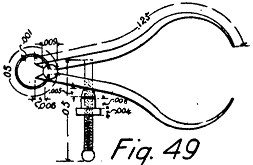

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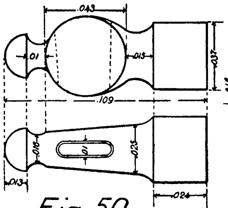


Fig. 50.

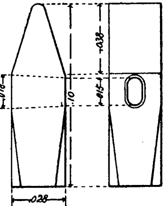
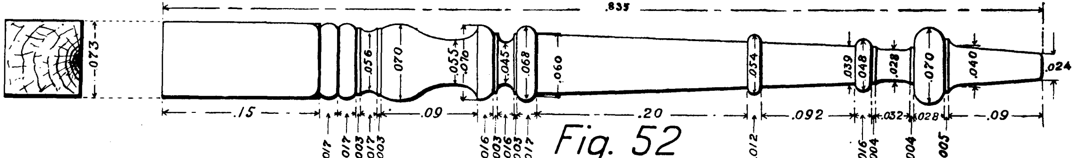


Fig. 51



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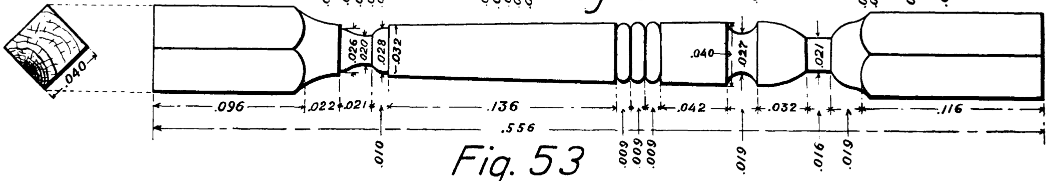

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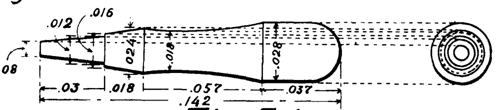


Fig. 54

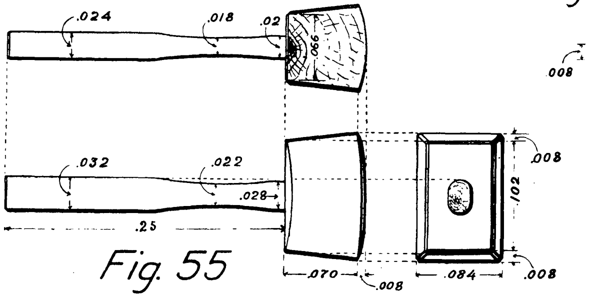


Fig. 55

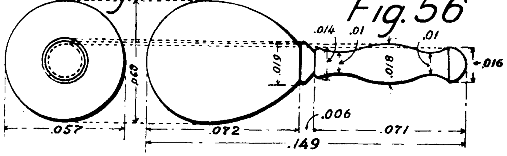


Fig. 56

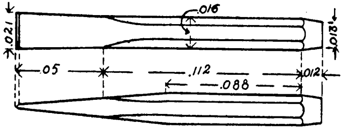
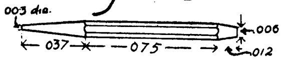
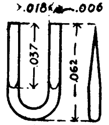


Fig. 57

Fig. 58





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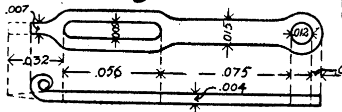

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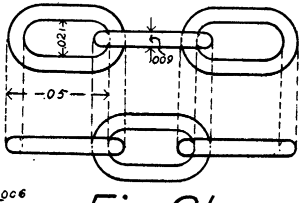

Fig. 61

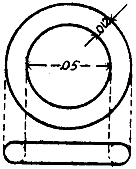

Fig. 62

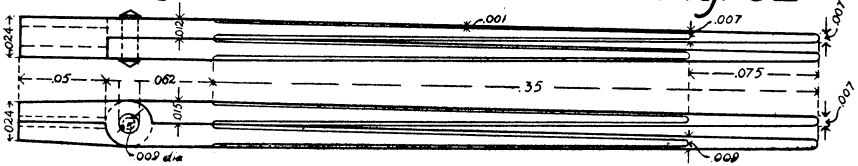

Fig. 63

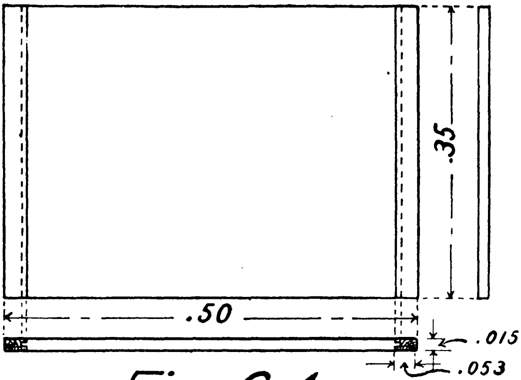

Fig. 64

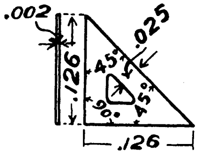

Fig. 65

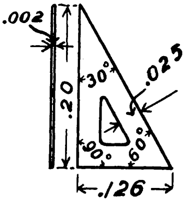

Fig. 66

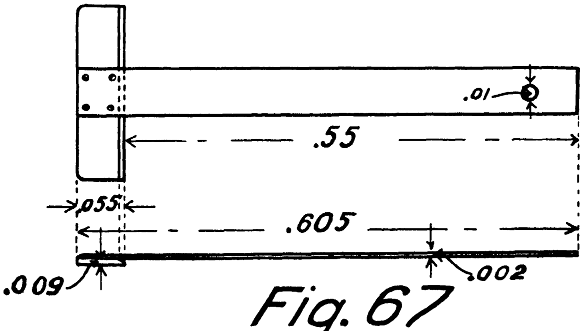

Fig. 67

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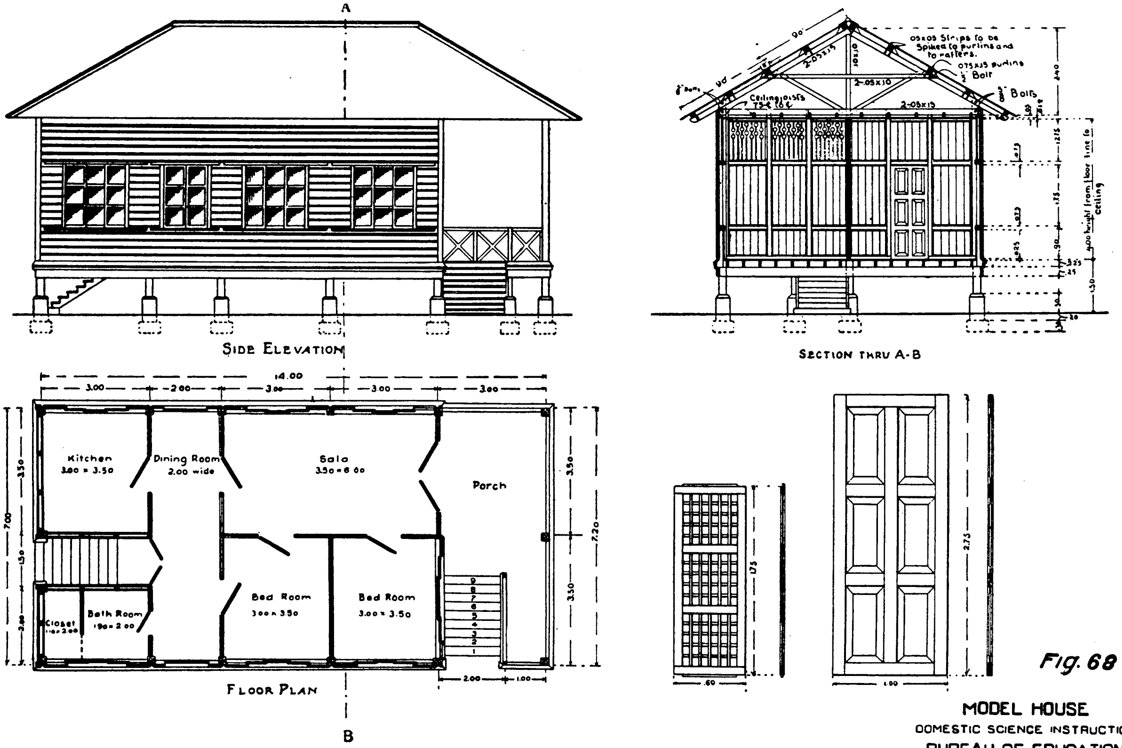


Fig. 68

MODEL HOUSE
DOMESTIC SCIENCE INSTRUCTION —
BUREAU OF EDUCATION

SECOND SEMESTER.

PLATE 46, A, B, C, D, ETC. (52 hours).

W. W. (*Original work.*)—Draw plan and necessary elevations of a small house. For suggestions see figs. 68 to 71 B.

NOTE.—The pupil is not to copy these figures, but to make his own sketches and submit them to the teacher for approval. The following plates are suggested as a complete set of drawings for a house:

- A. Plan
  - First floor.
  - Second floor.
  - Ground and roof plan if necessary.
- B. Elevations
  - Front.
  - Side.
  - Any other that may be necessary.
- C. Cross section.
- D. Details
  - Framing: roof, trusses, joints, post-cap.
  - Windows and framing.
  - Doors and framing.
  - Stairs, etc.

I. W.—Plan, elevations, cross section, and details of school engine.

NOTE.—The following specifications for houses are given in English units instead of metric. This is in accordance with Act No. 1843. The drawings and finished dimensions are to be in decimal parts of a meter. In each case the finished dimensions (metric) are given so as to agree with the requirements of the mechanical drawing course.

GENERAL DESCRIPTION (Fig. 68).

This plan is adapted from "Plans for a Model Filipino House" issued by the Bureau of Education in 1904. The floor plan remains nearly the same, the principal difference being that the present plan represents the house as being constructed of wood instead of nipa, with the necessary changes incident to this style of construction. If built of the following materials by a private individual the house should cost about ₱2,000 to ₱2,500: Roof, galvanized iron; posts, ipil; girders, apitong; floor and steps, apitong or guijo; siding ("cove"), 5″ to 8″, tangili, almon, or lauan; doors and window frames of apitong; window sills, ipil, yacal, or apitong; sheathing and ceiling, tangili, $\frac{1}{2}''$ (half lap, or T & G); footings, concrete, 1 part cement, 3 of sand and 6 of gravel.

If the house is built of nipa, it should cost about ₱600, using the following materials: Roof and siding, nipa; posts, ipil base with apitong top; girders, apitong; floor, bamboo; windows, nipa; sheathing and ceiling, matting ("sauale" or "amacan.")

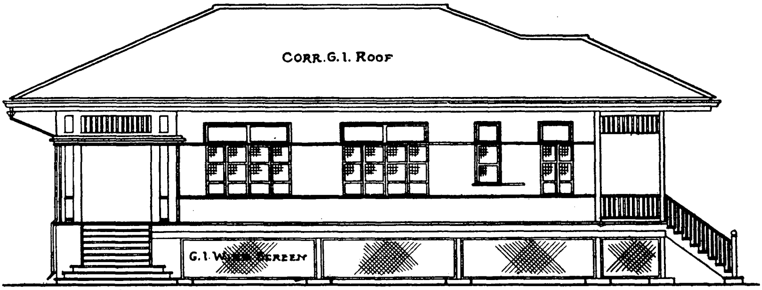
The accompanying illustration shows hinged doors and sliding windows, with the exception of those windows at each end of the dining room, which are to be hinged. The doors have raised panels. The base of the steps should rest on a concrete slab which is connected with the footings at each end. The posts rest on the footings and are held in place by iron straps embedded in the concrete. The partitions are of tangili, $\frac{3}{4}''$ by 5″, T & G, set in grooves in the framework (paneled). The grill over the bedroom partition allows for a good ventilation.

In order to make the siding more permanent, it should be painted with oil paint. The appearance of the building might be improved by inclosing the lower part with lattice work.

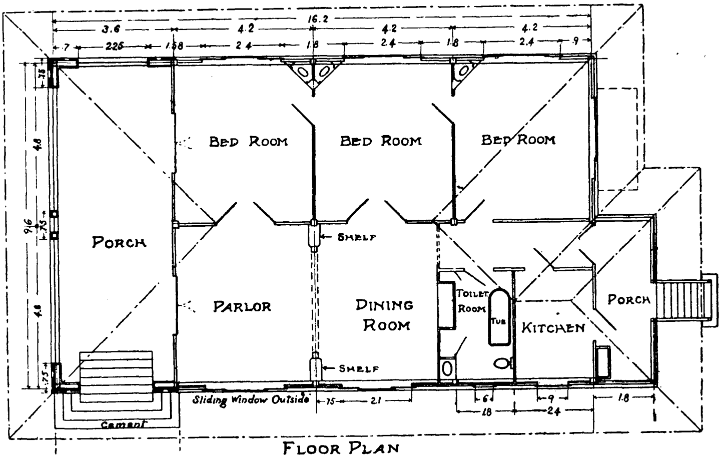
The usual paneled siding may be used, but the "cove" siding can be put on with less labor and will also keep out typhoon rains better than paneled work.

GENERAL DESCRIPTION (Figs. 69 and 70).

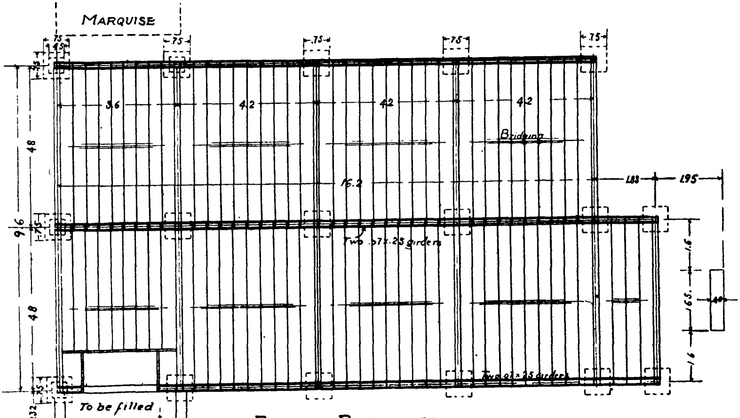
During the year 1910 a house was built in Manila, according to these plans, at a cost of ₱4,665, including a stable and servants' quarters, which are not shown in the drawings. These quarters are large enough to accommodate two horses, two carriages, store and feed room, and servants' toilet; above these are the servants' living rooms. Taking out the cost of these quarters leaves the cost of the house at approximately ₱4,000, without plumbing. First-class plumbing cost the owner ₱1,335. This includes hot and cold water in the three bedrooms, bathrooms, and kitchen; flush toilets, kitchen sinks, extra drain for stable, etc., all connected properly with the main sewer. For houses in the



SIDE ELEVATION



FLOOR PLAN



FRAMING PLAN Showing
FOUNDATION of FOOTINGS.

Fig. 69

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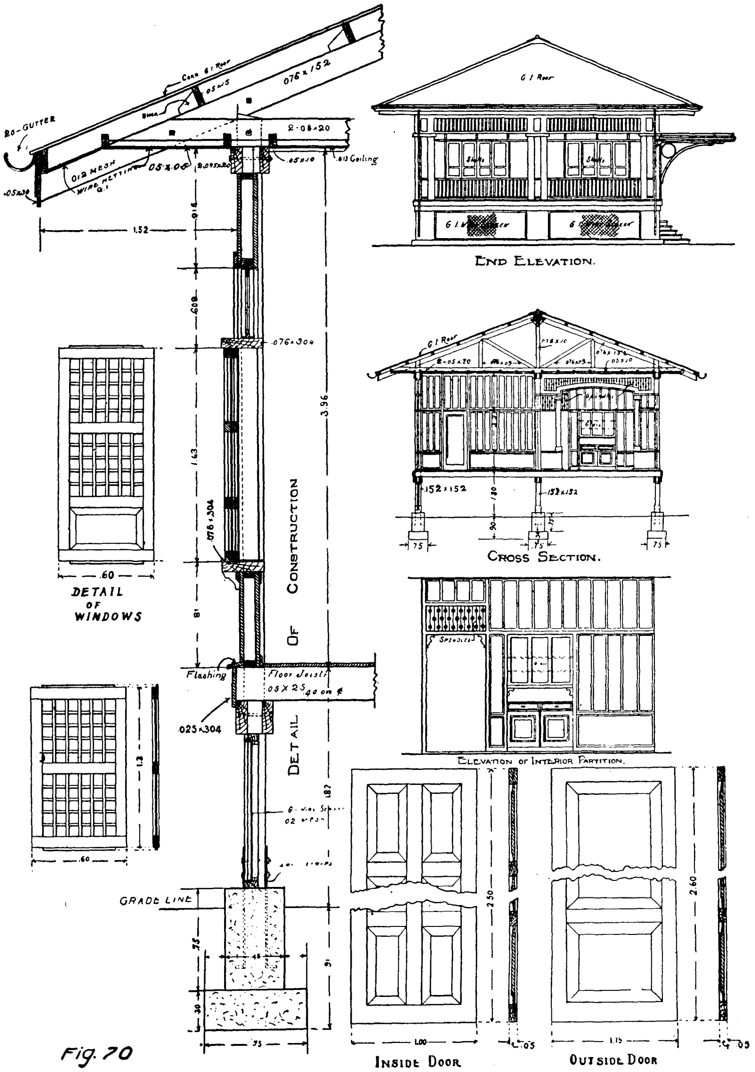


Fig. 70

UNIV OF MICH.

provinces, the plumbing could be made much simpler and cheaper, or omitted entirely.

The bathroom and kitchen should have concrete or tiled floors sloping toward a drain-pipe grating in the center of the floor. If a septic vault is provided (see Appendix), this drainage, together with that of a flush toilet, may be disposed of in a sanitary manner.

In cities where there is no water system, an iron tank at the rear of the building could be used as a water supply for the bathroom, toilet, and kitchen. This could be filled with rain water in the wet season, and, at other times, by a small hand force-pump connected with a covered well. The tank and well should be made mosquito-proof by providing tight-fitting covers.

In the construction work the posts are ipil; girders, apitong; floors, guijo, 1″ by 4″, T & G; siding, interior, and ceiling, tangili; door and window frames, guijo or apitong; lower windows ("ventanillas"), tangili; window sills, molave or ipil.

The footings are concrete,—1 part cement, 3 of sand, and 6 of gravel or broken stone. The porch is supported by four posts, one at each corner and two in the middle; the others are imitation posts, as are also the posts supporting the grill and arch. The marquise top slopes a little toward the building, but the slope is hidden by the cornice. The marquise is supported by wrought-iron brackets. The siding is matched (T & G), but might be paneled according to the custom of the country. "Cove" siding would be better. The sheathing, partitions, and ceiling are of tangili, 1″ by 10″, with battens fitted so as to give the effect of panels. (See fig. 70, cross section and elevation.) It is finished in oil so as to show the grain of the wood.

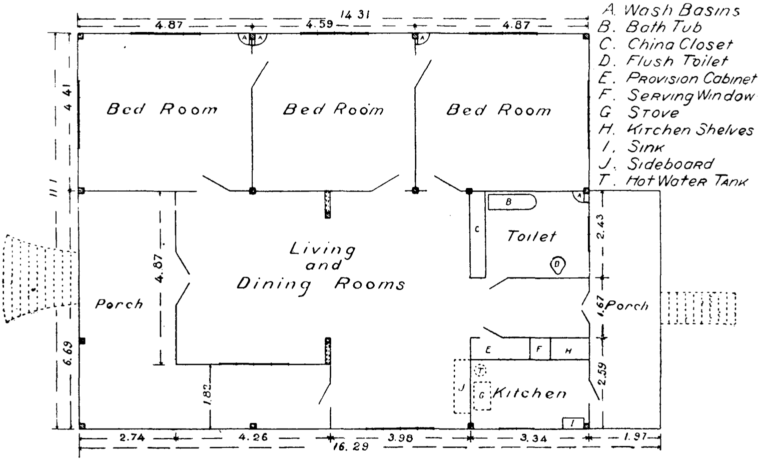
A china closet is built in the wall between the dining room and the bath room. It is made of narra, polished; the upper part having glass doors, 3 shelves, plate racks, and cup hooks. The middle is open. The drawers should be lined with felt or plush. The two doors below inclose a cupboard for ordinary dishes, etc.

All doors should have raised panels. (See section).

Wash basins in each bedroom and the bathroom.

ALTERNATE PLAN.

During the construction of this house, the owner changed the floor plan so as to break up the box-like appearance and straight-line arrangement of the rooms. Some of the advantages are as follows: The house is wider, and has a better appearance from the street; the kitchen and toilet are more conveniently located; the porch on two sides keeps the living room cool at all times; the location of the provision cabinet "E," etc.



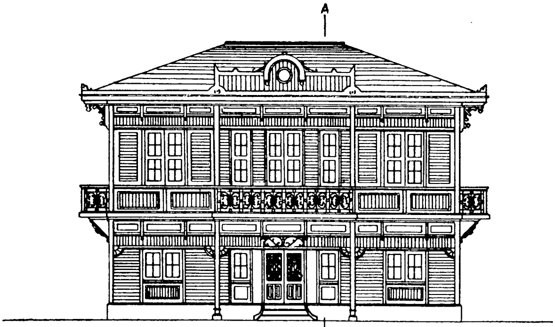
ALTERNATE FLOOR PLAN OF FIG. 69.

The cost of the house, mentioned in the first paragraph of the general description, applies to the house as constructed in accordance with this latter floor plan; however, the cost would be about the same if the original plan were used.

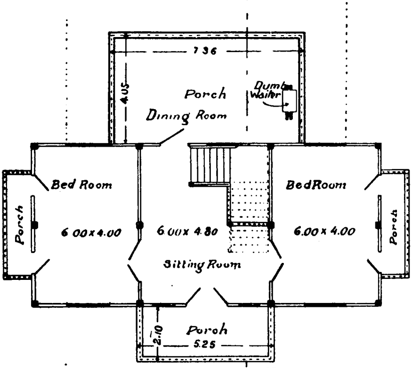
GENERAL DESCRIPTION (Figs. 71-A and 71-B).

This house was constructed in Manila in 1905, at a cost of ₱8,000, using hard-wood posts, soft-wood siding, wainscoting, sheathing, and ceiling, and guijo floors. It is still in excellent condition.

One large family or two ordinary families can be accommodated very nicely, and have separate dining rooms, above and below. The porch dining room has a wide-projecting



FRONT ELEVATION



SECOND FLOOR PLAN

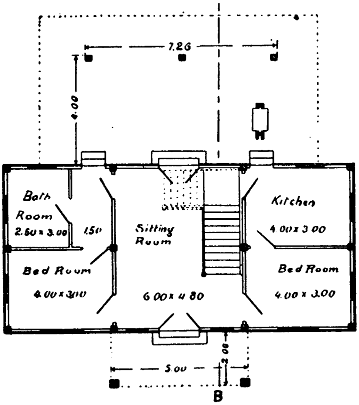


Fig. 71-A FIRST FLOOR PLAN

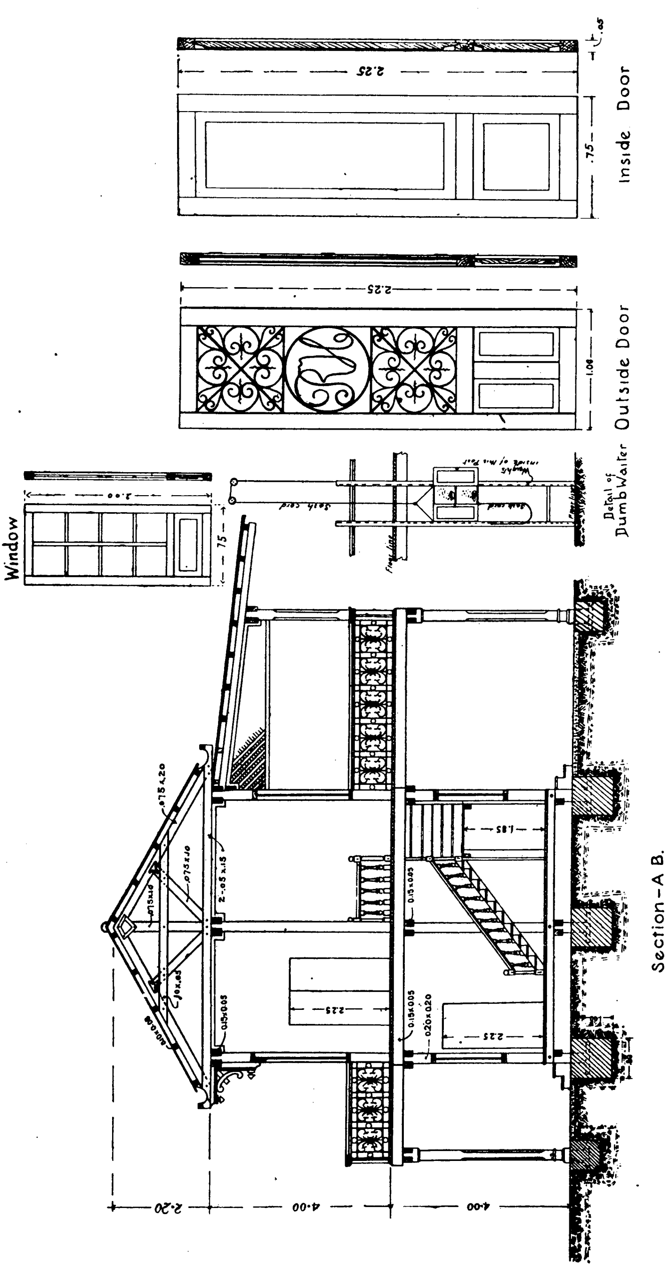

Window
2.00
75
Outside Door
2.25
1.08
Inside Door
2.25
.75
.05
Detail of DumbWaiter
Sash cord
Floor line
Weights inside of Mn Post
Section-A B.
2.20
4.00
4.00
1.85
2.25
2.25
0.15x0.05
0.20x0.20
0.15x0.05
0.15x0.05
2-.05x.15
.075x.20
.075x.10
.075x.10
.10x.05
.10x.08

Fig. 71-B

roof, and is connected with the kitchen by means of a dumb waiter, thus insuring prompt service. If it is necessary to have the upper and lower floors entirely separate, then an extra kitchen, bathroom, and toilet should be attached to the rear or one side of the upper porch.

The side porches are connected with the bedrooms by means of two narrow doors having hinged windows (glass or shell) extending two-thirds of their length. All outside doors are arranged in the same manner, the lower ones being supplied with fancy grill work. (See details, fig. 71 B.) All doors and windows have brass hinges and full length slide bolts (European style). A water supply, similar to that suggested for fig. 69, can be installed, and a flush toilet can be located in a small room partitioned off from one side of the bathroom and having a separate entrance.

If this house is built on low ground, the piers should be extended high enough to place the exposed portions of the posts well above the water level.

PART III.

FREE-HAND AND DECORATIVE DRAWING.

GENERAL SUGGESTIONS.

PENCILS.

For free-hand work use a soft pencil.

The teacher must see that the pencils are kept in proper condition and should distribute them at the beginning and collect them at the close of each lesson. In sharpening the pencil cut away the wood without cutting the lead; then wear off one side leaving a flat surface. This form of point will produce the wide gray line desired for this work, if the pencil is held lightly with the fingers 8 or 10 centimeters from the point.

PAPER.

For the ordinary paper work use "Catalan" paper.

For brush work use "German white" or other good quality.

For construction work use "oak tag" or heavy "manila tag board."

ERASER.

No use of the eraser should be permitted until the object has been sketched and mistakes corrected; then the eraser may be used at the discretion of the teacher.

INK.

Use sticks of Chinese ink which can be purchased everywhere. This may be prepared by putting some water in a small dish and rubbing the stick of ink on the dish until the desired color is obtained.

BRUSH.

A medium size camel's-hair brush (about No. 7) is to be preferred, but the ordinary Chinese brush will do good work. Be sure to clean the brush each time after using. During the long vacation the brushes should be kept where moths can not destroy them. Place them in boxes with camphor or moth balls.

PASTE.

Whenever paste is needed for construction work, it can be made from flour or rice.

COLORS.

All of the work outlined can be done with a soft pencil, colored pencils, and ink; but the interest and value of the work will be greatly enhanced if water colors can be provided. Tubes of water color give much better results than the tablets.

Provide each pupil with a piece of soft cloth or with blotters for wiping brushes.

RULERS.

Metric rulers should be used, if possible.

BLACKBOARDS.

Much blackboard work should be permitted on the part of the pupils to develop freedom of expression. Free drawing before the class by the teacher will also aid the work.

ILLUSTRATIONS.

The illustrations in this book are merely suggestive and should not be copied.

GROUPING.

When grouping is called for, several groups should be arranged on model stands or boards between the desks, in order that each pupil may see the objects in proper relation. When fruits or vegetables are used for groups, a piece of pottery may be placed with the group to give height.

In arranging a group consider the following points:

(*a*) Are the objects interesting?

(*b*) Do they have any relation to each other?

(*c*) Is there sufficient contrast in size, shape and position?

CLASS INSTRUCTION.

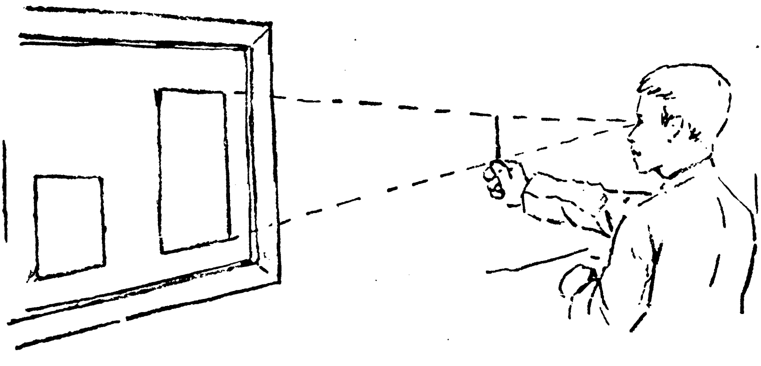
In giving class instruction and criticism of general mistakes, the teacher should be sure that he has the undivided attention of every pupil in the class.

PREPARATION FOR THE LESSON.

The teacher should prepare in advance an outline of the different steps to be taken in developing the lesson. He must also secure in advance all models, etc., needed for study or for purposes of illustration. He should encourage pupils to assist in providing material, but should not rely upon them entirely in that regard.

PENCIL MEASUREMENTS.

In order that pupils may get better ideas of proportion, it is necesary to make comparative measurements with the pencil held at arm's length between the pupil and the object to be drawn. Draw on the blackboard two figures of different sizes; e. g., square and oblong. Hold pencil vertically at arm's length between the eye and the taller object. Close one eye and look with the other eye across the top of the pencil to the top of the object; then move the thumb up or down along the pencil until it marks the bottom of



the object. Now change to the smaller object, still holding the thumb as a mark for the height of the first, and indicate the height of the second by means of the forefinger of the other hand. Compare these heights fractionally as one-half or one-third, etc., and used these proportions in drawing the same figures on practice paper. For horizontal measurements, hold the pencil horizontally and proceed as described above.

This method of pencil measurement must be used in all object drawing.

TIME.

The time allowed by the present course of study is two eighty-minute periods per week. It is not expected, however, that all of the work outlined can be completed without giving time outside of the class.

COURSE FOR GRADE V.

JUNE.

Construction.	*Applied design.*	*Pictorial drawing.*
Teach use of ruler. Plan pattern for envelope for year's drawings. Cut and make same.	Design decorative arrangement for envelope. Develop geometric unit. Transfer design to face of envelope. NOTE.—Simple border or corner design. (Figs. 79 and 80.)	*Object drawing.* Study appearance of circular card at different levels. Study cylinder, cone, and hemisphere below level of eye. Teach pencil measurement. Teach use of accented line. (Fig. 95.)

JULY.

	Practice flat wash with tints of the six standard colors, one color for each sheet. Practice wash of six standard colors arranged in squares on one sheet. Paint decoration on envelope, using color or Chinese ink. Study use of stripes in textiles. Design arrangement suitable for sinamay and jusi cloth. Complete in harmonious colors.	Draw cylindrical object below level of eye; e. g., native bowl, half of orange or other fruit. Draw cylindrical object above level of eye; e. g., inverted pail hanging on bamboo. (Figs. 96 to 101.)

AUGUST.

	Study use of checks and plaids in textiles. Design two arrangements suitable for native fabrics, including cloth, matting, blankets, or other local products. Complete in harmonious colors.	Teach foreshortening of top face of cube and prism, parallel perspective. Draw closed book, parallel perspective, a little below level of eye. Draw open book in similar position. (Figs. 102 to 107.)

SEPTEMBER.

Construction.	*Applied design.*	*Pictorial drawing.*
Teach use of compasses. Teach geometrical construction of rectangle and square. Plan pattern and make square or rectangular box.	Plan geometrical unit. Apply to decoration for handkerchief box. Transfer design and complete in ink or color. (Fig. 81.)	Teach use of pencil in rendering light and shade. Teach principles of grouping and use of "blocking-in" lines. Draw group consisting of glass of water, lemon or orange, cube of sugar, etc. (Figs. 108 and 109.)

OCTOBER.

Plan pattern for embroidered piña handkerchief.	Draw and conventionalize leaves of various shapes. Use as unit for decoration of piña handkerchief. (Fig. 82.)	Draw group consisting of candlestick, partly burned candle, and box of matches. Draw group consisting of bowl and beet or radish with leaves. Make wash drawing of native jar. Review semester's work by examination. (Fig. 110.)

NOVEMBER.

Teach geometrical construction of equilateral triangle. Make pattern and construct triangular candy box.	Plan decoration for candy box. Use leaf form or geometrical unit. Transfer and complete in ink or color. (Fig. 83.)	*Plant forms.* Draw grasses and sedges. Study growth. Make wash drawing of grasses and sedges with seeds and flowers. (Fig. 111.) Draw flower spray. Study curling and foreshortening of leaves. (Fig. 112.)

DECEMBER.

Cut Christmas and New Year's cards.	Practice lettering for use on cards. Make and transfer designs for Christmas and New Year's cards. Complete in ink or color. (Fig. 84.)	Draw fruit spray. Make wash drawings of similar nature forms.

JANUARY.

Construction.	*Applied design.*	*Pictorial drawing.*
Plan and make calendar mounts.	Plan decoration within suitable inclosing form. (Use some of the plant forms previously studied.) Complete in ink or color and apply as decoration of calendar mount. (Figs. 85 and 86.)	Make wash drawings of groups of fruit and vegetables. (Fig. 113.)

FEBRUARY.

Plan pattern for embroidered handkerchief.	Draw and conventionalize simple flower or small vine. Use as unit for decoration of embroidered handkerchief. Transfer and complete. (Fig. 87.)	*Life and action.* Teach general proportions of human figure from pose, in straight-line action figures, and silhouettes. Study "Can't you Talk," Hilts, Book I; "The Shepherdess," Book II. (Figs. 114, 115, 116.)

MARCH.

	Practice lettering. Design monograms and initials to be used on handkerchiefs, underclothes, etc. Make several designs of various sizes. Transfer all to one sheet of paper to be used as pattern. (Figs. 89 to 94.)	*Landscape.* Teach growth and form of masses of foliage and trees. (Work from observation, if possible.) Devote extra time to review of year's work for deficient pupils and optional work for advanced pupils. (Figs. 117 and 118.)

SPECIAL DIRECTIONS FOR THE WORK OF GRADE V.

JUNE.

NOTE.—For this month's work the teacher will supply circular cards, cylinders, cones, hemispheres, and a variety of cylindrical objects.

1. *The envelope.*—Put this pattern on the blackboard. Have pupils copy carefully on manila paper and construct.

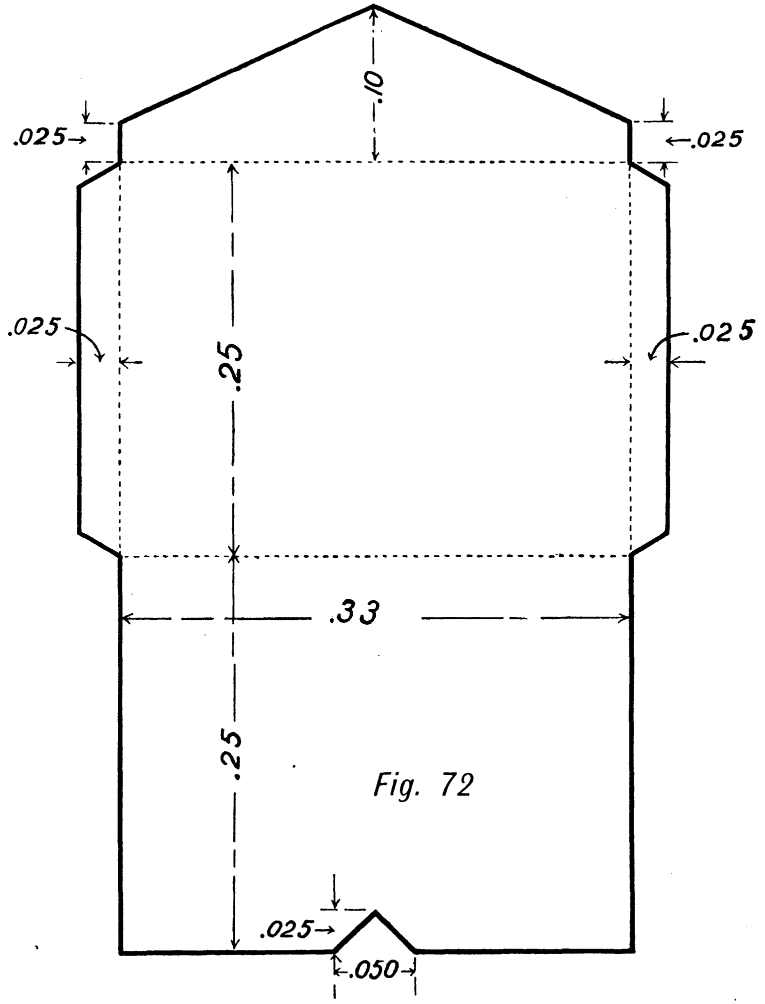


Fig. 72

One sheet will make four envelopes. (This shape was selected because of the economical use of paper involved.) In all work in construction, aim to secure dexterity in handling instruments and accuracy in measuring.

The corner and border designs (figs. 79 and 80) will serve as suggestions. Observe that they are simple units. Be sure that all work in design is strictly original.

Emphasize *simplicity.* Try to develop appreciation of beauty of form and line in units designed for decoration.

2. *Cylindrical objects.*—Draw and cut out circles of cardboard or heavy paper 10 centimeters in diameter. Have each pupil hold one horizontally, so that only the edge will be seen; this may be represented by a horizontal line. Move the circle up or down and observe that the effect is changed. This foreshortened circle is called an *ellipse.* Sketch card in different positions on practice paper.

Hold the cylinder so that the top face is on a level with the eye. Do the same with the circular face of the cone and hemisphere. In each case the circle is seen as a straight line. Move the objects up or down and the circle will appear as an ellipse. Make a sketch of a half glass of water representing three ellipses of varying sizes. Each pupil must make these sketches.

NOTE.—Do not attempt light and shade in this work. Sketch in *outline* only.

JULY.

1. *Flat wash.*—In making a flat wash, the color must be spread evenly. It is easier to do this if the paper is held in a slanting position. The usual method is to fill the brush with color, begin at the top of the left side, and spread the color with a rapid movement to the right. Repeat until the surface is entirely covered, being careful to keep the brush *full* of color. Excess color may be removed by touching lightly with the *edge* of a blotter, or a dry brush.

2. *Native fabrics.*—Before designing native fabrics, collect samples that are good in coloring and design. In making stripe designs, the width of stripes and spaces between stripes must be carefully considered.

3. *Rectangular objects.*—The accompanying sketch (fig. 73) of a square card is intended to illustrate *parallel perspective.* Observe that the near and far edges are parallel

to your horizon. They do not appear to change their direction, while the receding edges appear to slant upward. If

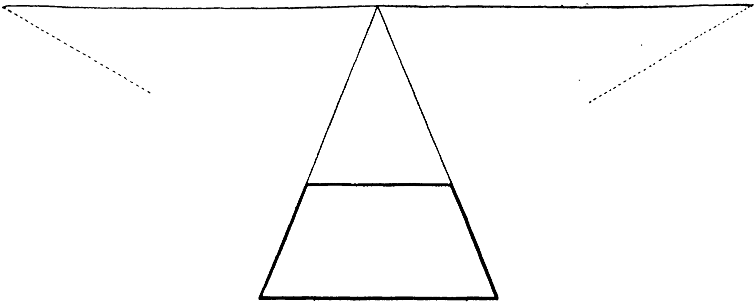


Fig. 73

the card were held above the level of the eye the receding edges would appear to slant downward to the level of the eye.

4. *Books.*—In drawing a book, select a thick one rather than a thin one. Emphasize the fact that the book is thick; that it is lying down; that the cover has thickness; that the leaves do not usually extend to the edge of the covers.

AUGUST.

1. *Native fabrics.*—Collect samples of native fabrics typical of the locality, and design pleasing arrangements of checks and plaids that can be applied to local products. Aim for harmonious combinations of colors. Avoid brilliant colors.

SEPTEMBER.

(Teacher will supply several groups, consisting of a glass, lemon or orange, and cubes of sugar. Arrange these groups in different parts of the room.)

1. *Rectangle and square.*—Teacher explain method of construction. Use "oak tag" or heavy "manila" paper.
2. *Compass.*—For method of using, see fig. 10.
3. *Pattern for box.*—(Oblong or square.)

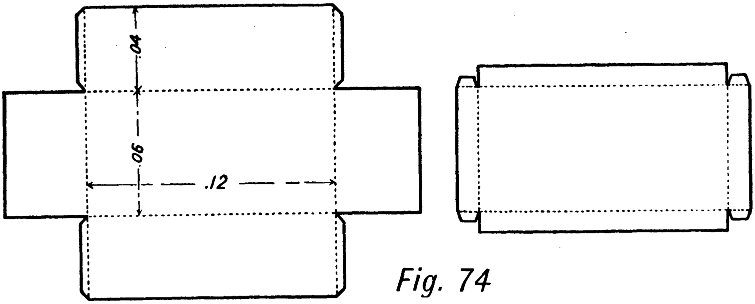


Fig. 74

4. *Arrangement of group.*—See general suggestions.

OCTOBER.

(Teacher will supply candlesticks, box of matches, bowl, beets or radishes, native jars, etc., for several groups.)

1. *Conventionalization.*—An endless number of designs may be made by using geometric forms only; but some of our most beautiful designs are made from suggestions obtained from plant forms. When we do not show the actual appearance of a plant or its parts, but make certain changes by simplifying or by omitting irregularities in order to adapt it to some special use, we have what is called *decorative* or *conventional* treatment.

NOVEMBER.

(Teacher will supply grasses, sedges, and flower sprays.)

1. *Pattern for box.*—For construction of triangle, see fig. 170, problem 6.

The design may be applied directly to the box or to water color paper to be used for covering the box.

2. *Plant forms.*—See that each pupil places his specimen in a natural position, and do not permit him to alter this position until the sketch is completed.

In drawing the grasses and sedges, look for the greatest width of leaf. Study the size and direction of stems and be sure to express the upright growth. In wash drawings, try to make each grass leaf with one stroke of the brush without any previous use of the pencil.

DECEMBER.

(Teacher will supply fruit sprays, etc.)

1. *Lettering.*—Any style of letters may be used. For suggestions see figs. 89 to 94 and "Fancy initials." For plain letters see fig. 20–A.

JANUARY.

(Teacher will supply groups of fruit and vegetables.)

1. *Calendar.*—Calendar mount may be made from cardboard or "oak tag." Cover with gray paper or water color paper, to which flat wash has been applied, and mount decoration. Calendars may be purchased at local stores or made by pupils.

FEBRUARY.

Teacher will place on the blackboard straight-line action figures. Pupils should make many similar figures to illustrate other forms of action. In pose drawings, work quickly; endeavor to obtain correct proportion and avoid details. First mark the entire height, then the parts needed for the head, waist, length of skirt or trousers, etc. Next consider the width of these parts. Look for the long lines of the figure and sketch with light broken lines.

MARCH.

Lettering.—See "Book of Alphabets" (Ginn & Co.) supplied to each division.

In representing trees and foliage, show leaves and branches as masses with no attempt to represent them in detail.

COURSE FOR GRADE VI.

JUNE.

Construction.	*Applied design.*	*Pictorial drawing.*
Plan and make envelope for year's drawings.	Design decoration for envelope. Develop units from geometric or plant forms (Fig. 121.) Transfer decoration, letter, and complete.	*Object drawing.* Teach principles of angular perspective by use of square card, cube, or prism. Study these at equal angles. (Fig. 132.)

JULY.

	Draw and conventionalize flower or small twig with flower. (Fig. 120.) Use as unit for surface design for native fabrics. (Fig. 119.)	Study cube turned at unequal angles. Draw closed book, angular perspective, unequal angles. (Fig. 123.) Draw open book in similar position. (Fig. 134.) Draw group of books at various angles. (Fig. 135.)

AUGUST.

	Study harmony in use of colors. Design decoration and color scheme for native fabrics suitable for camisa and skirt to be worn with same. Transfer and complete in color.	Draw group consisting of teapot, cup and saucer, or market basket with fruit or vegetables. (Fig. 136.)

SEPTEMBER.

Teach geometrical construction of regular hexagon on given base and within circle. Plan and make hexagonal box.	Design decoration for hexagonal box. Use plant form. Transfer and complete in color. (Fig. 122.)	Study triangular prism placed horizontally at unequal angles. (Fig. 137.) Draw partly opened book in similar position. (Fig. 138.)

OCTOBER.

Construction.	*Applied design.*	*Pictorial drawing.*
Plan pattern for embroidered center piece.	Draw and conventionalize "Aurora" vine. Use in design for embroidered center piece. Plan design in quadrants. Transfer and complete. (Fig. 123.)	Place triangular prism on square prism forming house model. (Fig. 139.) Study same at different angles. Sketch from memory or observation house of similar shape. (Fig. 140.) Review by examination.

NOVEMBER.

Plan patterns for plate and tumbler doilies.	Plan design for plate and tumbler doilies to accompany centerpiece. Use similar treatment of "Aurora" vine. Transfer and complete. (Figs. 124 and 125.)	*Plant forms.* Wash drawings of flower sprays, sprays with seed pods, etc., inclosed in rectangles to secure good space divisions and balance. Use "finder" (fig. 163), cut out and mount. (Fig. 141.)

DECEMBER.

Cut Christmas and New Year's cards.	Practice lettering to be used on Christmas and New Year's cards. Arrange decoration. Transfer and complete in ink or color. (Fig. 126 and 127.)	Make wash drawings of various plant forms inclosed in suitable geometric figures. (Fig. 142.)

JANUARY.

Cut cards or program covers.	Design decoration for menu, place card, or program. Transfer and complete in color or ink. (Fig, 128.)	Make original illustrations for stories read or compositions written.

FEBRUARY.

Construction.	*Applied design.*	*Pictorial drawing.*
Plan and cut book cover.	Plan decoration and lettering for cover design. Complete in color or ink. (Fig. 129.)	*Life and action.* Make several drawings from pose; e. g., girl writing at blackboard, etc. (Fig 143.) Show few details and aim for quick, accurate work. Study "The Angelus," Hilts, Book III. "By the River," Hilts, Book III.

MARCH.

Make post cards.	Compose landscapes or figure studies. Transfer and complete in color. (Figs. 130 and 131.)	*Landscape.* Compose landscapes from memory, imagination, or observation. (Fig. 144.) Use pencil, brush and ink, or color. Review for deficient pupils and optional work for advanced pupils.

SPECIAL DIRECTIONS FOR THE WORK OF GRADE VI.

NOTE.—Teacher will be careful to provide *all* the materials, objects, etc., required for each day's work.

JUNE AND JULY.

ENVELOPE.

(For pattern see Grade V.)

For this decoration, plant forms may be used. Emphasize simplicity.

ANGULAR PERSPECTIVE.

1. *Objects at equal angles.*—Begin study by holding top of cube on level of eye. Observe that all surfaces seen opposite the eye (fig. 75) appear as horizontal edges and

that the two lower edges appear to slant upward meeting the horizon line at the vanishing point at right and left.

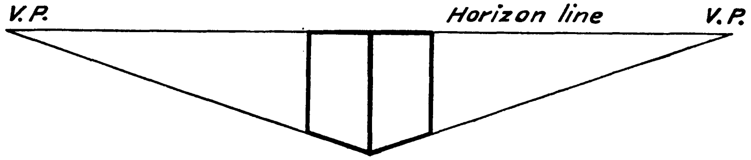


Fig. 75

Neither face of the cube appears in its true proportions; that is, it is foreshortened.

Now place the cube so that the top is slightly below the level of the eye (fig. 76). Observe that the top appears a long narrow diamond; that is, foreshortened. All the parallel horizontal edges appear to slant upward toward

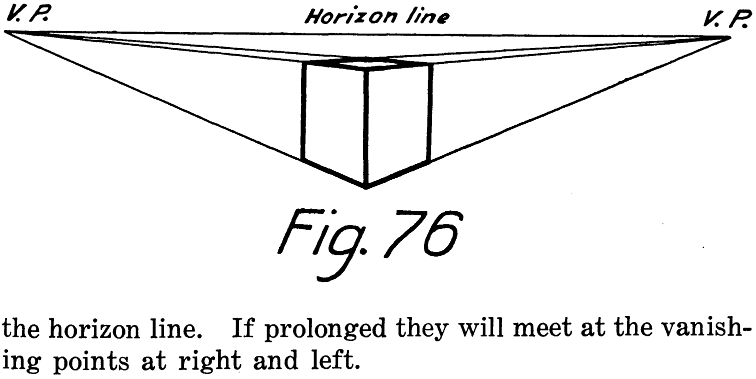


Fig. 76

the horizon line. If prolonged they will meet at the vanishing points at right and left.

Continue this study by holding cube above the level of the eye.

2. *Objects at unequal angles.*—Place the cube slightly below the level of the eye (fig. 77) and so turned that one

face appears wider than the other. Observe that the upper and lower edges of the wider face appear more nearly horizontal than the corresponding edges on the more foreshortened side; therefore, it is always true that the more a face is turned away from the observer, the more foreshortened it will appear, and the greater will be the slant of the lines.

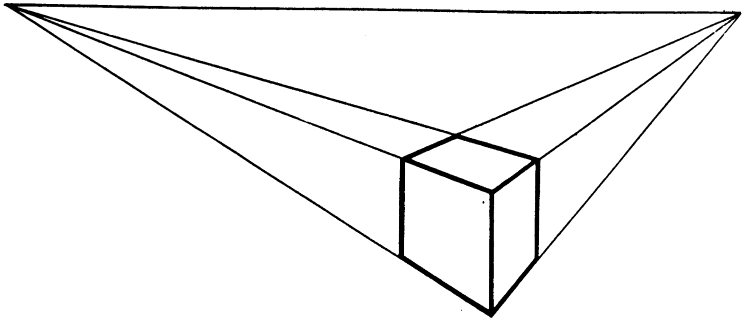


Fig. 77

Continue studying by holding the cube at several different levels. Apply the same principles to a closed book, open book, and various other objects. Much practice will be necessary.

3. *Conventional treatment of flower or twig.*—In conventionalizing plant forms, many changes may be made: For example, many of the angles or curves may be omitted; the size may be enlarged or reduced; the proportions may be changed; the parts of the unit may be separated, etc.

In making a surface design, some method of dividing up the spaces for the repetition of the unit is necessary. This may be estimated. After deciding upon a geometric working plan, place your design in a 20- or 25-centimeter square.

AUGUST AND SEPTEMBER.

1. *Native fabrics.*—Continue the work begun in the preceding month, giving particular attention to harmonious coloring.

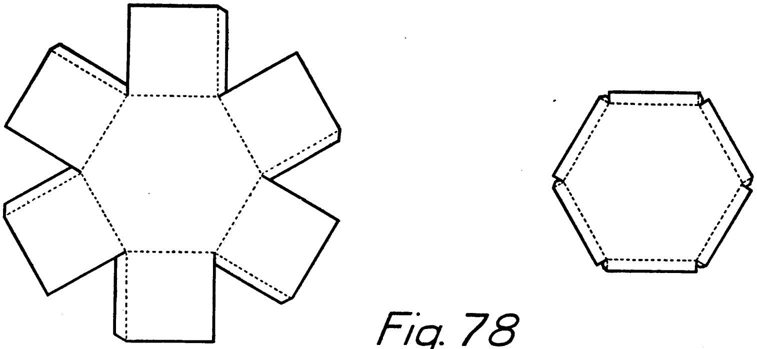


Fig. 78

2. *Hexagonal box.*—For construction of a hexagon within a circle or on a given base, see fig. 171, Prob. 12.

Eight to twelve centimeters is a convenient size for the diameter of the hexagon.

OCTOBER AND NOVEMBER.

1. *Centerpiece.*—A circular space may be divided and decorated in several ways. By drawing the horizontal and vertical diameters, the space may be divided into quadrants; by setting off the radius six times on the circumference, it will be divided into sextants. Either of these divisions will be convenient to use in designing the center piece.

2. *House model.*—If convenient, take the class out of doors and sketch from observation.

3. *Inclosing form.*—After a drawing has been made, a "finder," as illustrated in fig. 163, may be used to select the most interesting part of the sketch. This may be cut out

of cardboard or heavy paper and preserved for future use. After locating the best part of the picture, cut out that part included within the finder and mount in a suitable manner on gray paper or water color paper that has been given a wash of an appropriate tint.

DECEMBER AND JANUARY.

Original illustrations.—This work may be correlated with the work in English. Caution pupils not to try to show too much in one illustration. Work for simplicity and good composition.

FEBRUARY AND MARCH.

1. *Book covers.*—In order that these designs may have some practical use, it is suggested that a book for mounting magazine pictures, photographs, etc., be made, and the decoration applied to the covers.

For this purpose, take two pieces of cardboard about 0.18 by 0.23 m. for covers. For the leaves use gray paper, slightly smaller. Punch holes through leaves and covers and bind with a cord.

2. *Post cards.*—Cards may be made from "oak tag" or heavy water color paper. On one side of these a covering of some native fabric may be pasted and a water color sketch made on the same. Cards of this sort have had a ready sale wherever made, as they are typical of the country and unique in style.

3. *Landscape.*—Teach meaning of "foreground," "middle distance," and "background." When sketching from observation, use a "finder." Unequal spaces are usually more pleasing than equal ones. The principal object of interest should be *near* the center of the picture space, *not in it.*

COURSE FOR GRADE VII.

JUNE.

Construction.	*Applied design.*	*Pictorial drawing.*
Plan and make envelope or portfolio for drawings.	Design decoration and lettering for envelope or portfolio. (Figs. 145 and 146.) Transfer and complete in color.	*Object drawing.* Review foreshortening of circular face above level of eye. Make sketch of group of Japanese lanterns on wire above eye. Use ink or color. (Fig. 156.)

JULY.

Make paper lanterns for use in town fiestas.	Design suitable decoration for paper lanterns. (Figs. 147 and 148.) Transfer and complete in color.	Review principles of perspective. Make wash drawings of groups illustrating same; e. g., book partly opened placed horizontally on pile of closed books, etc. (Fig. 157.)

AUGUST.

Make covers and leaves for post card album.	Design decoration for cover for post card album. (Figs. 149 and 150.) Transfer and complete in color.	Study familiar objects with flat handles; e. g., sauce pan, teakettle, etc. Make several sketches of different positions. (Figs. 158 and 160.)

SEPTEMBER.

	Design embroidery to be used on white linen hand bag. (Fig. 151.) Transfer to paper pattern.	Study cylindrical object with round handle; e. g., chocolate pot, etc. Make several sketches of different positions. Make special effort to secure correct foreshortening. Draw group consisting of chocolate pot, spoon, etc. (Fig. 161.)

OCTOBER.

Construction.	*Applied design.*	*Pictorial drawing.*
	Make embroidery design for ruffle for use on underclothes. (Fig. 152.) Transfer to paper pattern.	Draw group consisting of chair placed in front of table on which book or vase with flowers is placed. (Fig. 162.) Review by examination.

NOVEMBER.

	Make embroidery design for table cover. Transfer to paper pattern. (Fig. 153.)	*Plant forms.* Paint simple grasses, sedges with seeds, etc., in colors. Arrange within suitable inclosing form. Cut out and mount.

DECEMBER.

	Make embroidery design for shirt waist (front, collar, and cuffs). (Figs. 154 and 155.)	Paint simple flower sprays in colors or ink. Select one to be cut out and mounted. (Figs. 163 to 165.)

JANUARY.

	Continue work on shirt-waist designs.	Paint in colors flowerpot with growing plant or native jar with vegetables, etc. (Fig. 166.)

FEBRUARY.

	Continue shirt-waist designs, underclothes, sideboard covers, etc.	*Life and action.* Study "The First Step," "The End of Labor," Hilts, Book IV. Make several sketches with pencil, or brush and ink, of the posed human figure. (Fig. 167.)

MARCH.

Construction.	*Applied design.*	*Pictorial drawing.*
	Continue shirt-waist designs, etc.	*Landscape.* Compose simple landscapes, illustrating principles of perspective; e. g., street bordered with trees, railroad track, etc. Review. (Figs. 168 and 169.)

GRADE VII.

JUNE AND JULY.

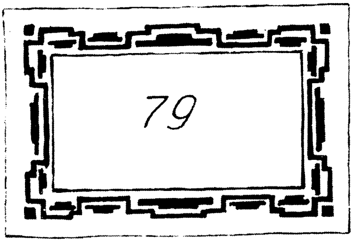
1. *Lanterns.*—For construction of these lanterns, the Japanese paper sold in the local stores may be used. Emphasize simplicity.

2. *Object drawing.*—Review carefully the principles taught in preceding grades.

AUGUST AND SEPTEMBER.

1. *Post-card album.*—This album can be constructed and decorated in a manner somewhat similar to the album for mounting magazine pictures, etc. Use leaves large enough for two or four cards and covers of a size suited to the same. Cut slits for inserting the corners of the cards, as shown in fig. 150.

For the succeeding months no special directions need be given, as no new principles are involved.



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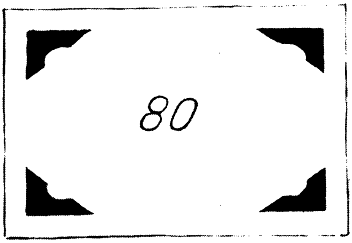

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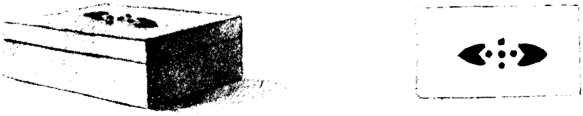

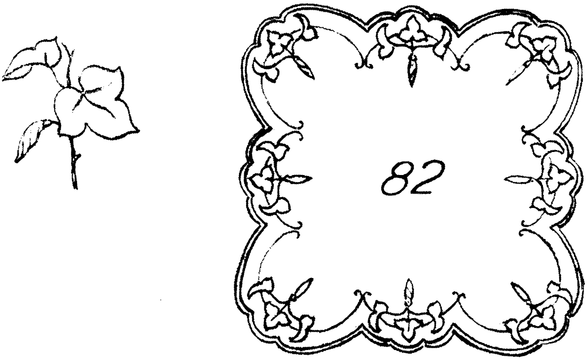

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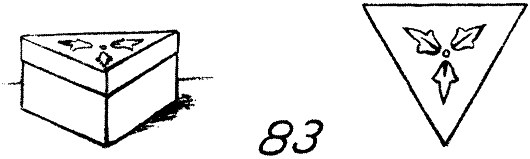

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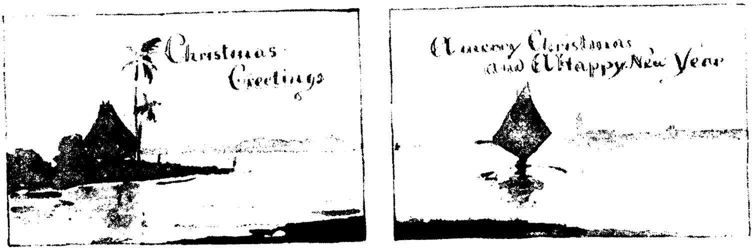
Christmas Greetings
A merry Christmas and A Happy New Year

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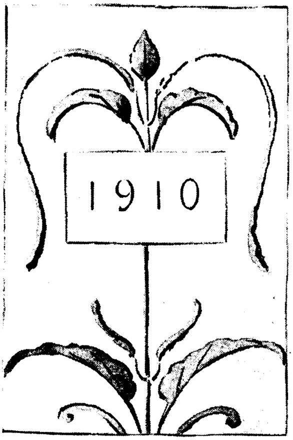

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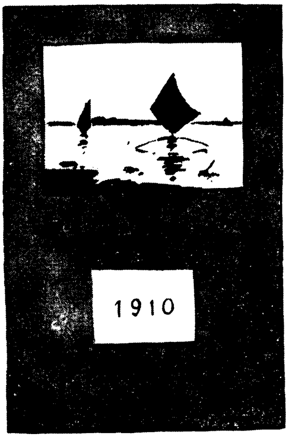

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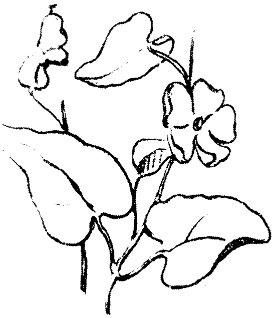

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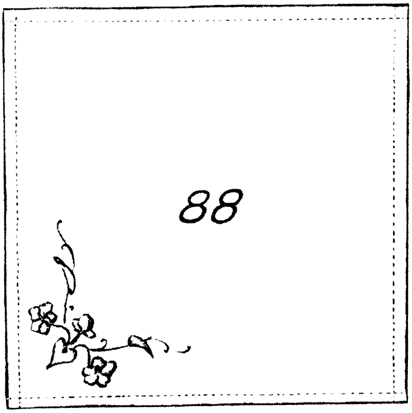

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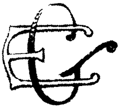

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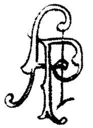

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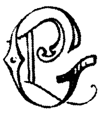

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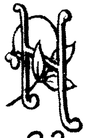

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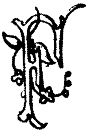

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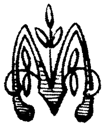

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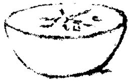
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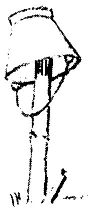
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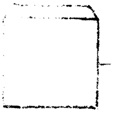
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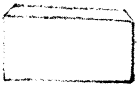
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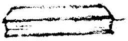
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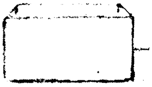
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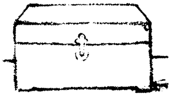
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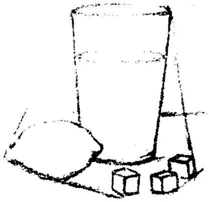
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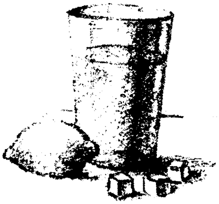
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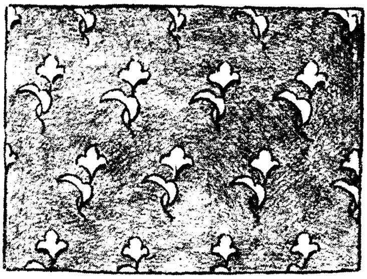

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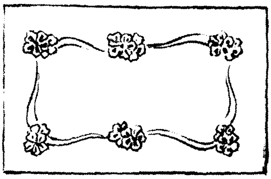

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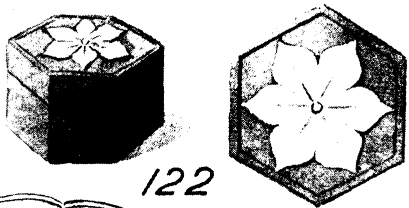

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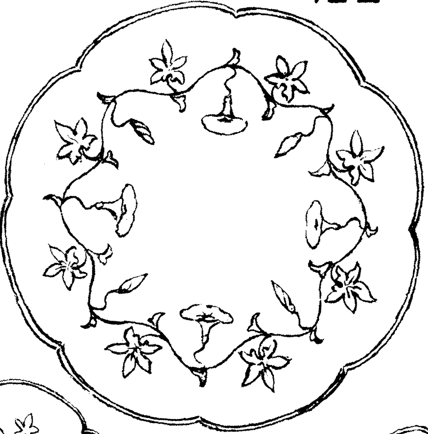

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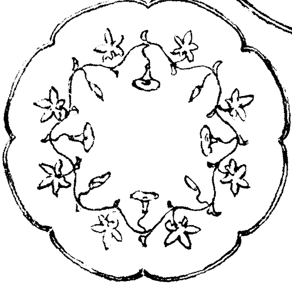

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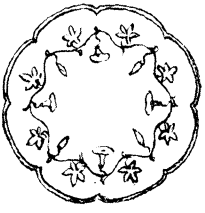

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Christmas Greetings.

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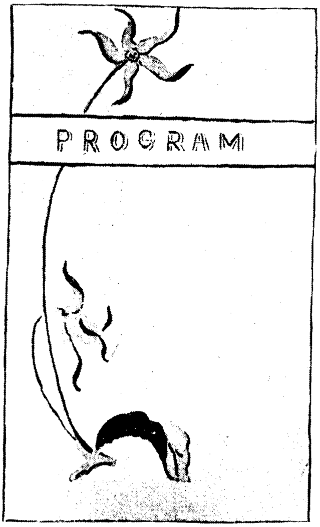

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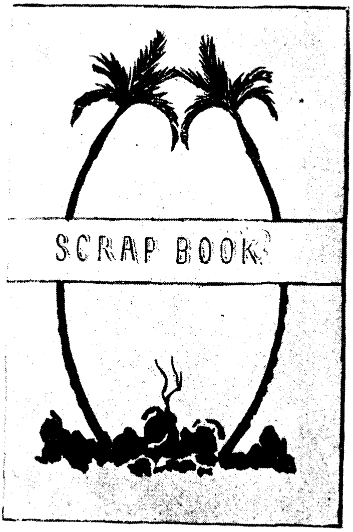

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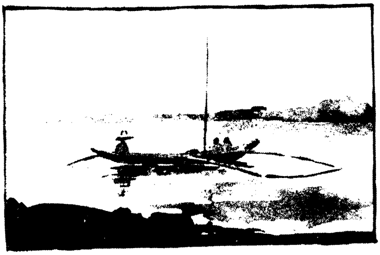

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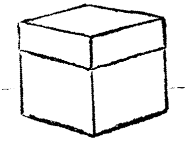

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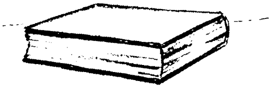

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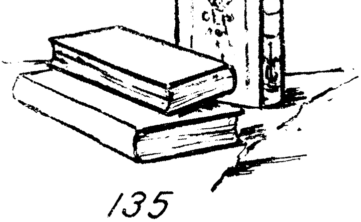

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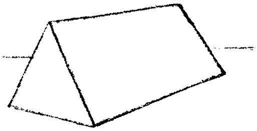
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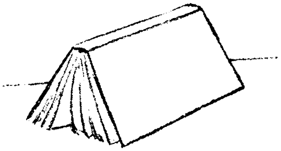
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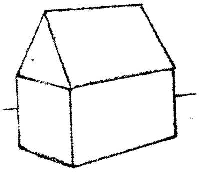
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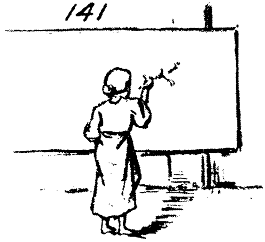
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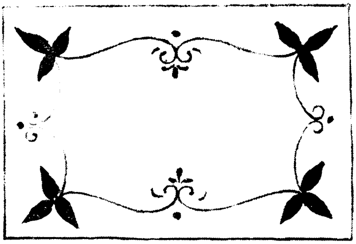

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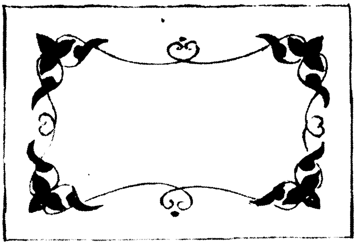

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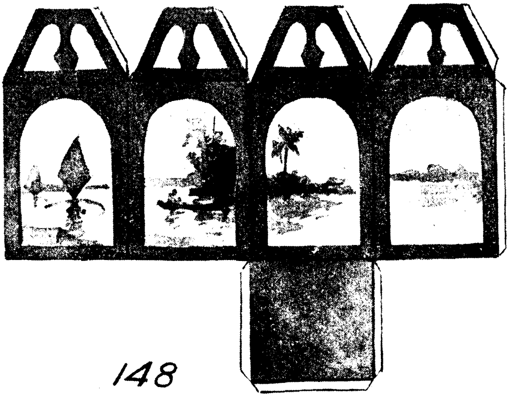

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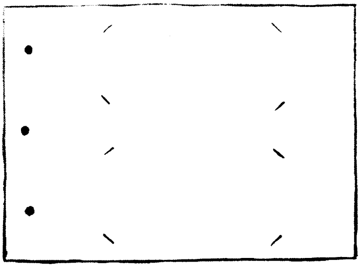

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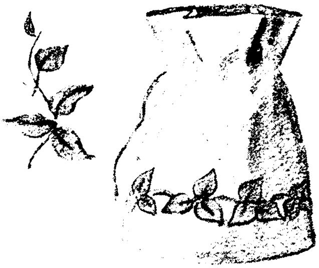

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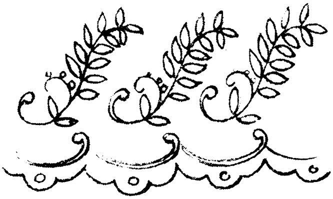

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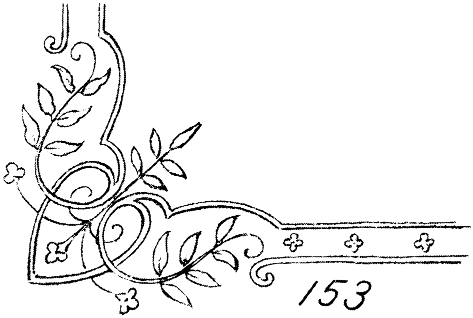

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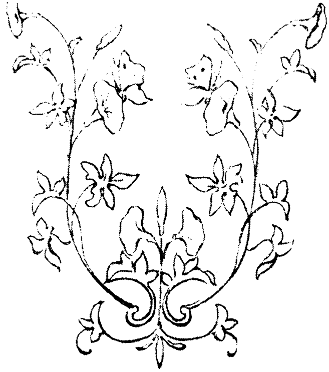

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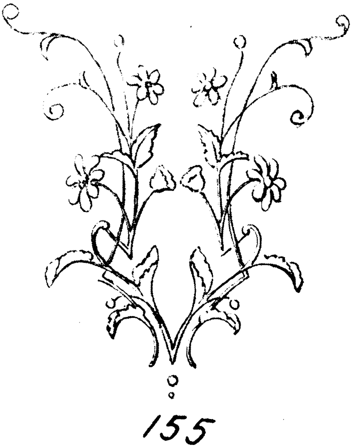

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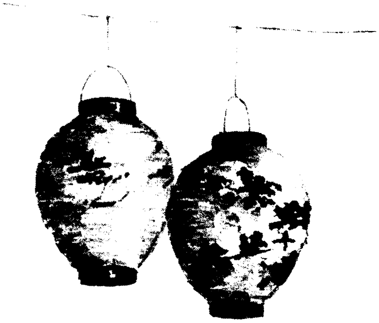

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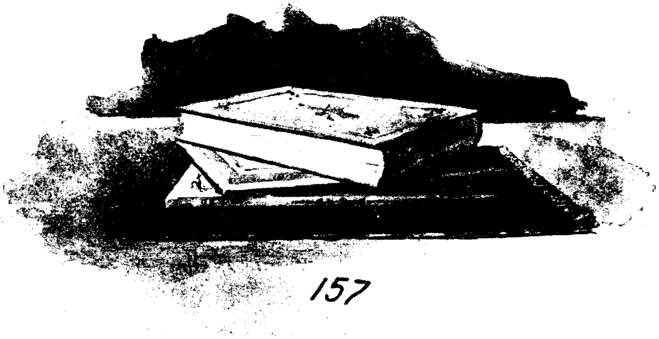

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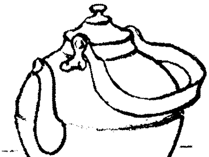

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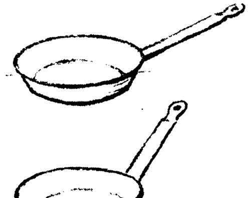

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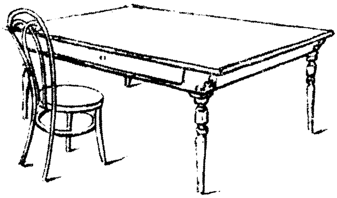

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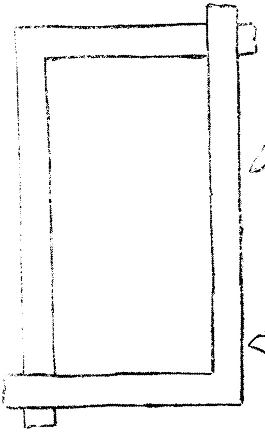

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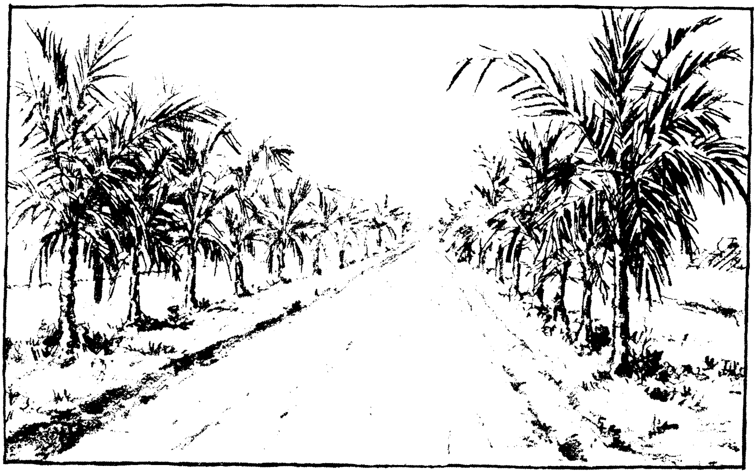

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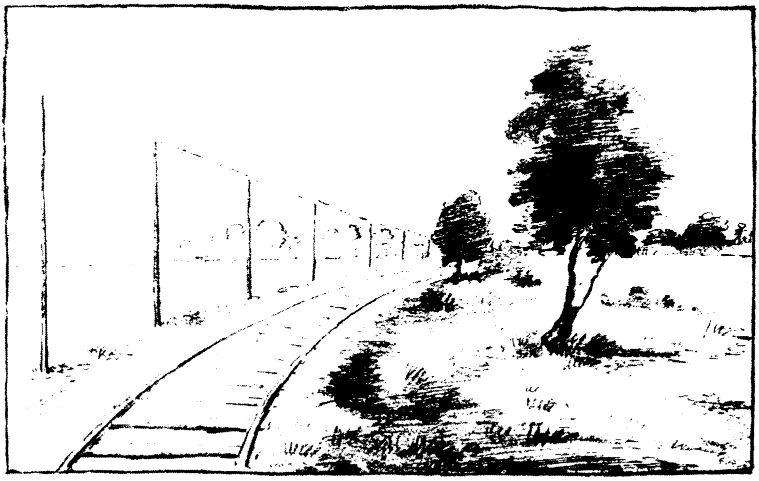

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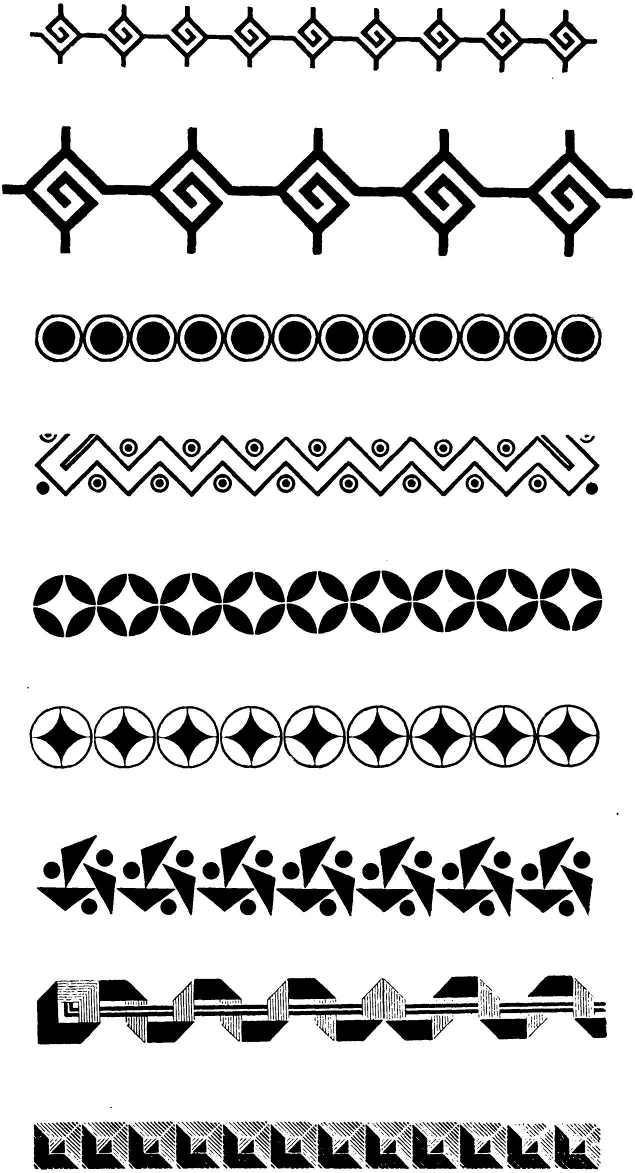

SUGGESTIONS FOR GEOMETRIC BORDERS.

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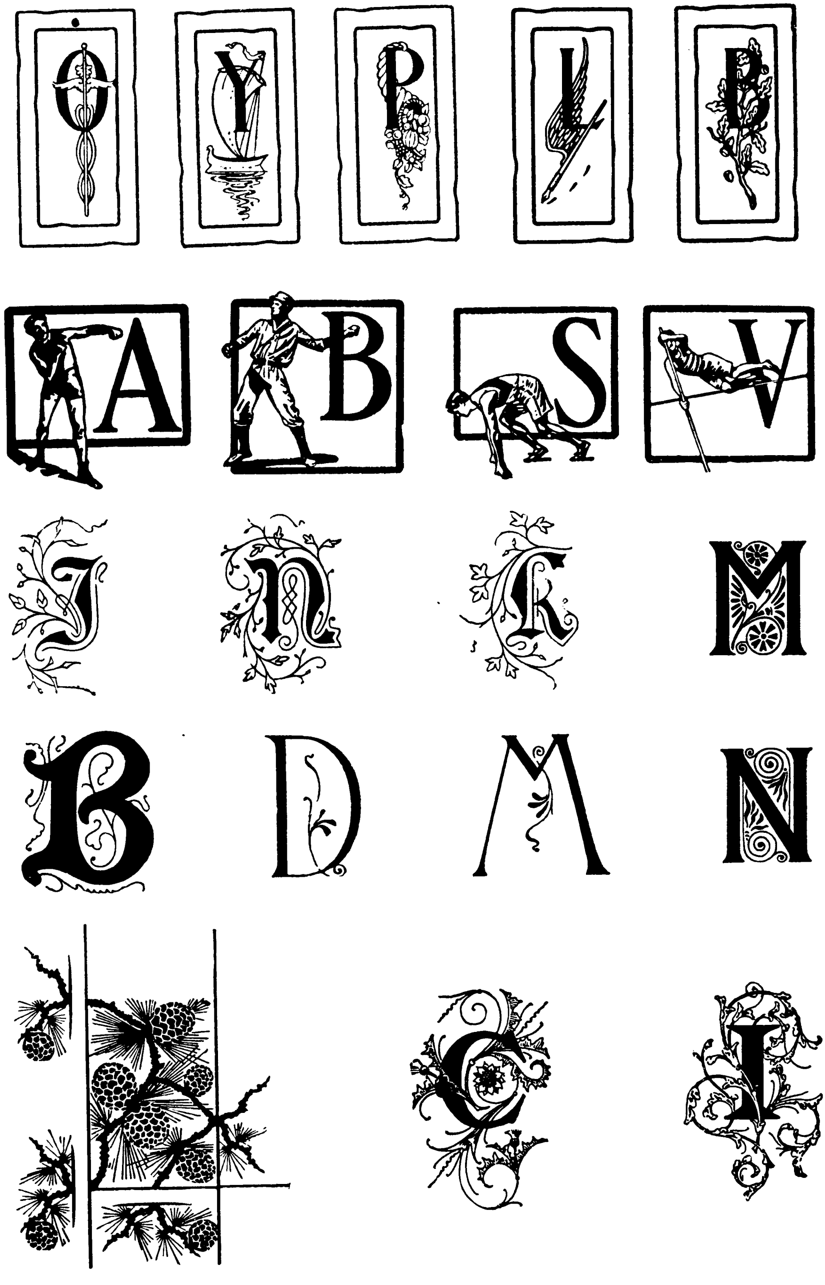
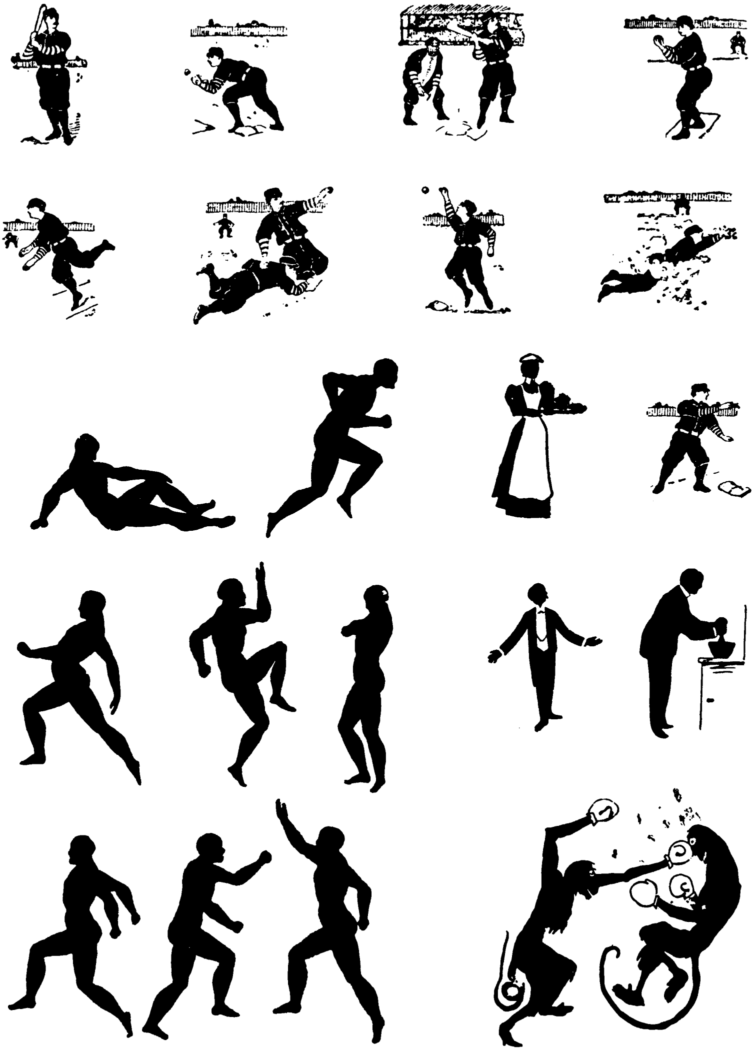


FANCY INITIALS, ETC.



ACTION STUDIES.

LIFE AND ACTION.

UNIV. OF MICH.

APPENDIX.

CONVERSION TABLES.

ENGLISH MEASURE TO METRIC.

INCHES TO METERS.

Inches.	Meters.	Inches.	Meters.	Inches.	Meters.	Inches.	Meters.	Inches.	Meters.
1/16	.0016	3	.0762	7¾	.1968	12½	.3175	30	.7620
3/16	.0048	3¼	.0825	8	.2032	12¾	.3238	31	.7874
5/16	.0079	3½	.0889	8¼	.2095	13	.3302	32	.8128
7/16	.0111	3¾	.0952	8½	.2159	14	.3556	33	.8382
⅛	.0032	4	.1016	8¾	.2222	15	.3810	34	.8636
⅜	.0095	4¼	.1079	9	.2286	16	.4064	35	.8890
⅝	.0159	4½	.1143	9¼	.2349	17	.4318	36	.9144
⅞	.0222	4¾	.1206	9½	.2413	18	.4572	37	.9398
¼	.0064	5	.1270	9¾	.2476	19	.4826	38	.9652
¾	.0191	5¼	.1333	10	.2540	20	.5080	39	.9906
½	.0127	5½	.1397	10¼	.2603	21	.5334	40	1.0160
1	.0254	5¾	.1460	10½	.2667	22	.5588	41	1.0414
1¼	.0317	6	.1524	10¾	.2730	23	.5842	42	1.0668
1½	.0381	6¼	.1587	11	.2794	24	.6096	43	1.0922
1¾	.0444	6½	.1651	11¼	.2857	25	.6350	44	1.1176
2	.0508	6¾	.1714	11½	.2921	26	.6604	45	1.1430
2¼	.0571	7	.1778	11¾	.2984	27	.6858	46	1.1684
2½	.0635	7¼	.1841	12	.3048	28	.7112	47	1.1938
2¾	.0698	7½	.1905	12¼	.3111	29	.7366	48	1.2192

FEET TO METERS.

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
1	.305	11	3.35	21	6.40	31	9.45	41	12.50
2	.609	12	3.66	22	6.71	32	9.75	42	12.80
3	.91	13	3.96	23	7.01	33	10.06	43	13.11
4	1.22	14	4.27	24	7.32	34	10.36	44	13.41
5	1.52	15	4.57	25	7.62	35	10.67	45	13.72
6	1.83	16	4.88	26	7.92	36	10.97	46	14.02
7	2.13	17	5.18	27	8.23	37	11.28	47	14.32
8	2.44	18	5.49	28	8.53	38	11.58	48	14.63
9	2.74	19	5.79	29	8.84	39	11.89	49	14.93
10	3.05	20	6.10	30	9.14	40	12.19	50	15.24

YARDS TO METERS.

Yards.	Meters.	Yards.	Meters.	Yards.	Meters.	Yards.	Meters.	Yards.	Meters.
1	.91	6	5.49	20	18.30	36	32.92	70	64.01
2	1.83	7	6.40	24	21.95	40	36.58	80	73.15
3	2.74	8	7.32	25	22.87	50	45.72	90	82.29
4	3.66	9	8.23	30	27.43	60	54.86	100	91.44
5	4.57	10	9.14						

ENGLISH TO METRIC.

No.	Linear.			Square.		Cubic.	
	Sixty-fourths of an inch to millimeters.	Inches to centimeters.	Feet to meters.	Square inches to square centimeters.	Square feet to square meters.	Cubic inches to cubic centimeters.	Cubic feet to cubic meters.
1	0.39688	2.54001	0.304801	6.45163	0.09290	16.38716	0.02832
2	.79375	5.08001	.609601	12.90325	.18581	32.77432	.05663
3	1.19063	7.62002	.914402	19.35488	.27871	49.16148	.08495
4	1.58750	10.16002	1.219202	25.80650	.37161	65.54864	.11327
5	1.98438	12.70003	1.524003	32.25813	.46452	81.93580	.14159
6	2.38125	15.24003	1.828804	38.70975	.55742	98.32296	.16990
7	2.77813	17.78004	2.133604	45.16138	.65032	114.71013	.19822
8	3.17501	20.32004	2.438405	51.61300	.74323	131.09729	.22654
9	3.57188	22.86005	2.743205	58.06463	.83613	147.48445	.25485

TRIC TO ENGLISH.

No.	Millimeters to sixty-fourths of an inch.	Centimeters to inches.	Meters to feet.	Square centimeters to square inches.	Square meters to square feet.	Cubic centimeters to cubic inch.	Cubic meters to cubic feet.
1	2.51968	0.39370	3.280833	0.15500	10.76387	0.06102	35.31445
2	5.03936	.78740	6.561667	.31000	21.52773	.12205	70.62891
3	7.55904	1.18110	9.842500	.46500	32.29160	.18307	105.94336
4	10.07872	1.57480	13.123333	.62000	43.05547	.24409	141.25782
5	12.59840	1.96850	16.404167	.77500	53.81934	.30512	176.57227
6	15.11808	2.36220	19.685000	.93000	64.58320	.36614	211.88673
7	17.63776	2.75590	22.965833	1.08500	75.34707	.42716	247.20118
8	20.15744	3.14960	26.246667	1.24000	86.11094	.48819	282.51564
9	22.67712	3.54330	29.527500	1.39500	96.87487	.54921	317.83009

DEFINITIONS.

1. A *point* indicates position without size.

2. A *straight line* is the shortest distance between two points. It has one dimension only—length.

3. A straight line may be *horizontal, vertical,* or *oblique.*

4. A line extending in the direction of, or parallel to, the horizon is *horizontal.*

5. A line drawn at right angles to the horizon is said to be *vertical;* if drawn at any other angle, it is *oblique.*

6. Lines which are everywhere equally distant from each other are called *parallel lines.*

7. A line changing direction at every point is called a *curved line.*

8. An *angle* is the difference in direction of two lines.

9. When a line moves about a point from a given position, it makes an angle with the given line. When the moving line has passed through one three-hundred-sixtieth of a revolution, the angle thus made is taken as a unit and is called a *degree.*

10. An angle measuring 90 degrees is a *right angle.*

11. An angle measuring less than 90 degrees is an *acute angle.*

12. An angle measuring more than 90 degrees is an *obtuse angle.*

13. A *surface* has length and breadth, but not thickness.

14. A *plane* surface is a flat, even surface.

15. A *polygon* is a plane surface bounded by straight lines.

16. A figure having all sides equal is *equilateral.*

17. A *triangle* is a polygon having three sides.

18. A *quadrilateral* is a polygon having four sides.

19. A *pentagon* is a polygon having five sides.

20. A *hexagon* is a polygon having six sides.

21. A *heptagon* is a polygon having seven sides.

22. An *octagon* is a polygon having eight sides.

23. A *nonagon* is a polygon having nine sides.

24. A *decagon* is a polygon having ten sides.

25. An *undecagon* is a polygon having eleven sides.

26. A *dodecagon* is a polygon having twelve sides.

27. A *circle* is a plane figure bounded by a curved line every point of which is equally distant from a point within called the center. The bounding line is called the circumference.

28. A *semicircle* is a half circle; half of a circumference is called a semicircumference; it contains 180 degrees.

29. An *equilateral polygon* is a polygon having all its sides equal, and an *equiangular polygon* is one having all its angles equal.

30. A *regular polygon* is both equiangular and equilateral.

31. An *isoceles triangle* has two of its sides equal.

32. A *scalene triangle* has no two sides equal.

33. A *right-angled triangle* has one right angle.

34. A *trapezium* is a quadrilateral having no two sides parallel.

35. A *trapezoid* is a quadrilateral having only two of its sides parallel.

36. A *parallelogram* is a quadrilateral whose opposite sides are parallel.

37. A *rectangle* is a parallelogram whose angles are all right angles.

38. A *square* is a rectangle whose sides are all equal.

39. A *rhomboid* is a parallelogram having only its opposite sides equal, but its angles not right angles.

40. A *rhombus* is a rhomboid having all its sides equal.

41. A *given line* is a fixed, known line.

42. *Lines of construction* are lines not given, but used in the solution of a problem.

43. To *describe* a figure is to draw it on a surface.

44. The lower or supporting part of a figure is called its *base*.

45. The *altitude* of a triangle is a straight line drawn

from the vertex perpendicular to its base; of a parallelogram, it is the perpendicular distance between the base and the opposite side.

46. The *perimeter* is the outer boundary of a figure, the sum of all its sides.

47. A *periphery* is the circumference of a circle, ellipse, or other curvilinear figure.

48. To *bisect* is to divide into two equal parts.

49. A line which divides an angle or another line into two equal parts is a *bisector.*

50. A *tangent* is a straight line that touches a curve at one point.

51. A *circumference* is the curved line that bounds a circle.

52. A *radius* is a straight line that extends from the center of a circle to its circumference. (Plural, *radii.*)

53. A straight line passing through the center of a circle and terminating in the circumference is a *diameter.*

54. An *arc* is a part of the circumference of a circle.

55. A straight line connecting the ends of an arc is a *chord.*

56. A *solid* has three dimensions—length, breadth, and thickness.

57. A *polyhedron* is a solid bounded entirely by planes.

58. A solid bounded by six equal squares, and having all its angles right angles is a *cube.*

59. A *prism* is a polyhedron having at least two of its faces equal and parallel and the other faces parallelograms.

60. A *pyramid* is a polyhedron having three or more faces radiating from a common point called the vertex; they inclose a polygon, which is called the base.

61. A *cone* is similar to a pyramid but has a circle for a base.

62. To *inscribe* within a given figure is to draw within the figure, touching its bounding line at every possible point.

63. To *circumscribe* about a given figure is to draw outside the figure, touching its bounding line at every possible point.

64. A line meeting a given line or surface at right angles is *perpendicular* to it.

65. The art of representing objects by lines is called *drawing.*

66. A drawing executed with the hand without the use of drawing intruments is called a *free-hand drawing.*

67. A drawing made with accuracy by the use of instruments, such as compasses, triangles, rulers, etc., is called a *mechanical drawing.*

68. A preliminary free-hand drawing or representation of an object is a *sketch.*

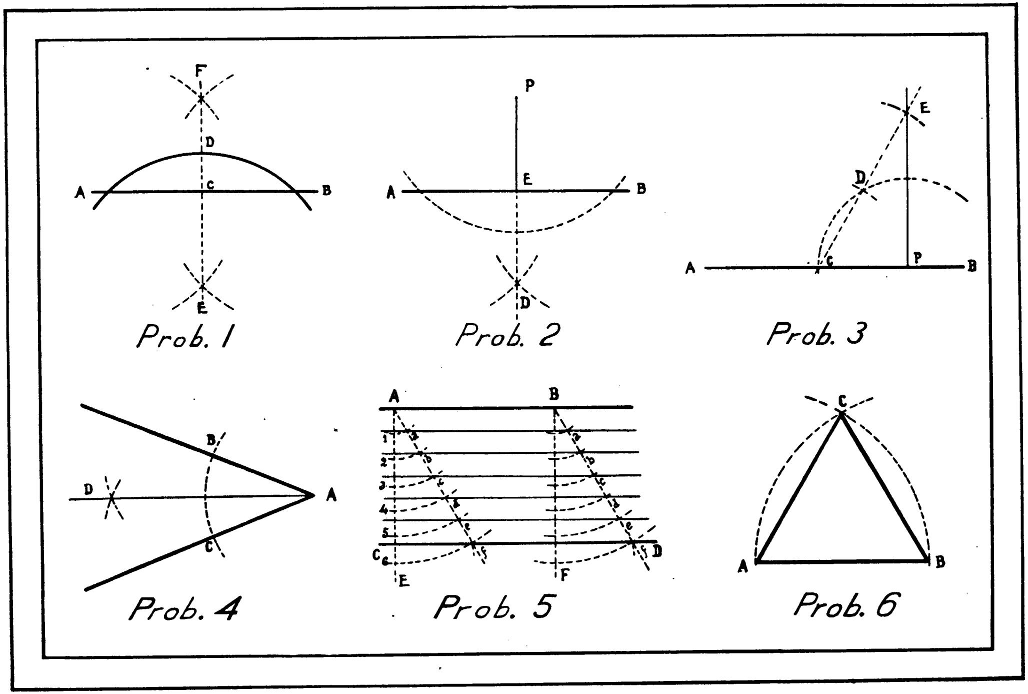
69. A *plan* is a mechanical drawing of a structure or object projected vertically into a horizontal plane.

70. A mechanical drawing of the upright parts of a structure or object as distinguished from the horizontal part or plan is called an *elevation.*

71. A material pattern of an object is called a *model.*

72. A system in which a fixed proportion is used in determining quantities is called a *scale.*

73. A drawing made to scale is called a *working drawing.*



Prob. 1 Prob. 2 Prob. 3

Prob. 4 Prob. 5 Prob. 6

Fig. 170

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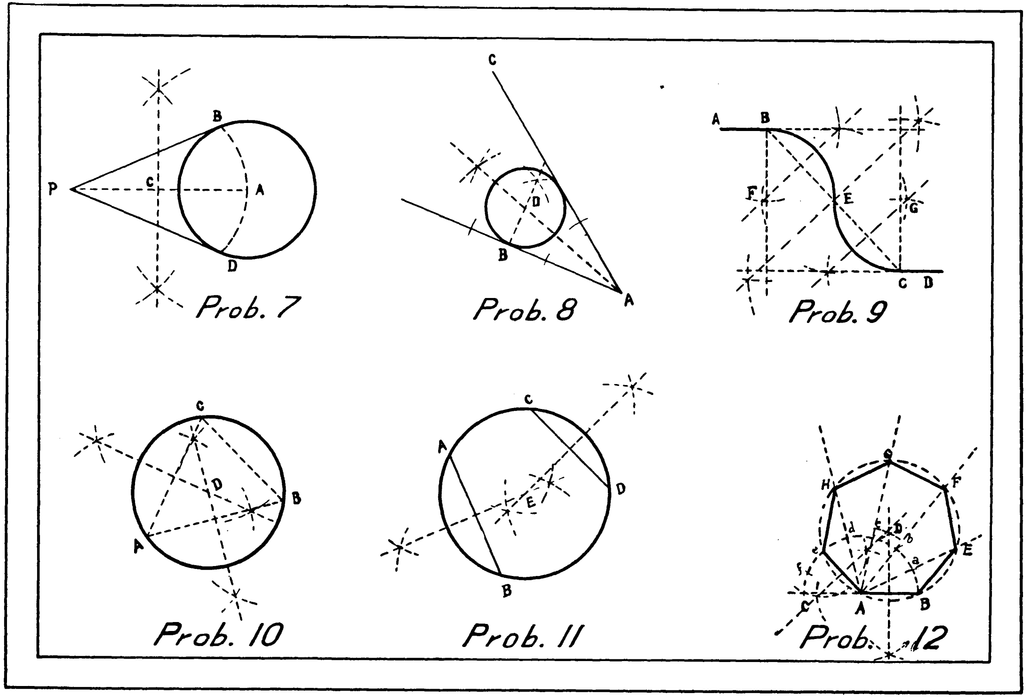


Prob. 7

Prob. 8

Prob. 9

Prob. 10

Prob. 11

Prob. 12

Fig. 171

GEOMETRICAL PROBLEMS.

Prob. 1.—To bisect a straight line *A B* or an arc of a circle *A D B*.

With *A* and *B* as centers and a radius greater than one-half of *A B*, draw arcs intersecting each other. Mark these points of intersection *F* and *E*. Draw a straight line from *F* to *E*. This line cuts *A B* at *C*, and the arc at *D*. *C* and *D* are the middle points required.

Prob. 2.—To draw a perpendicular to a straight line *A B* from a point *P* outside the line. With *P* as a center, draw an arc cutting the line in the points *A* and *B*. With the same radius, using *A* and *B* as centers, draw arcs intersecting at *D*. Join *P* and *D*. The line *P E* is the perpendicular required.

Prob. 3.—To erect a perpendicular to a line *A B* from a point *P* on the line.

With *P* and *C* as centers, draw arcs of equal radii intersecting at *D*. With *D* as center and the same radius, draw an arc at *E*. Draw a straight line from *C* through *D*, cutting the arc at *E*. Join *P* and *E*. *P E* is the perpendicular required.

Prob. 4.—To bisect any angle.

Let *B A C* be the angle. With *A* as a center and any radius, draw the arcs *B C*. With *B* and *C* as centers and any radius draw the arcs intersecting at *D*. Draw *A D*. *A D* is the bisector of the angle *B A C*.

Prob. 5.—To draw any number of equidistant parallel lines between two parallel straight lines. (In this case we will draw five.)

Let *A B* and *C D* be the two given parallels. Draw *A E* at any convenient angle to *A B*. With any convenient unit for spacing, lay off on *A E* as many equal spaces as lines required plus one (in this case six). Mark the points of division 1, 2, ... 6. With *A 6* as a radius and *A* as a center draw an arc from 6, cutting *C D* at *f*. Join *A f*. With the radius *A 5* draw an arc from 5 cutting *A f* at *e* . . . . 1 *a*. Make the same construction at *B*, drawing *B F* parallel to *A E*, using the same unit for spacing. Draw a straight line *a a*, ... *e e*.

Prob. 6.—To draw an equilateral triangle, one side *A B* being given. With *A* and *B* as centers and *A B* as a radius, draw arcs intersecting at *C*. Join *A C* and *B C*.

Prob. 7.—To draw a tangent to a circle from a point *P* outside. Draw a line from *P* through the center *A*. Bisect *P A*. With *C* as a center and *C A* as a radius, draw the arc *A B*. Join *P B*. This is the required tangent. By drawing *A D* a second tangent is obtained.

Prob. 8.—To draw a circle tangent to both sides of a given angle *C A B*, and tangent to a given point *B*, on one side of the angle.

Bisect the angle *C A B*. At *B* erect a perpendicular. The point *D* at which the perpendicular from *B* cuts the bisector, will be the center of the required circle.

Prob. 9.—To unite two parallel straight lines *A B* and *C D* with a reversed curve. Join *B* and *C*. Mark some point upon *B C* as *E*. Bisect *B E* and *E C*. Erect perpendiculars at *B* and *C*, cutting the bisectors at *F* and *G*. With *G* as a center and *C G* as a radius, draw the arc *C E*. With *F* as a center and *F B* as a radius, draw the arc *B E*. *B E C* is the curve required.

Prob. 10.—To pass a circle through three points, *A*, *B*, and *C*, not in the same straight line. Join the points *A*, *B*, and *C*, thus forming a triangle. Bisect any two of the sides. The intersection of the bisectors at *D* will be the center of the required circle.

Prob. 11.—To find the center of a circle.

Draw two chords, *A B* and *C D*. Bisect the chords. The bisectors meet at *E*, the center of the circle.

Prob. 12.—To draw a polygon of any number of sides upon a given base *A B*.

Extend the base line from *A* to *C*. With the center *A*, and *A B* as a radius, draw a semicircle. Divide this semicircle by trial into as many equal parts as there are sides in the required polygon (in this case seven). Mark the points of division *a, b, c,* . . . . . *f*.

Join *A e*. Bisect *A e* and *A B*. These bisectors will intersect at a point *D*. With *D* as a center and *D A* as a radius, draw a circle passing through *A B* and *e*. Extend lines from *A* through the points *a, b, c* . . . . Join *B E, E F, F G* . . . . .

Prob. 13.—To draw an ellipse, the axes being given.

Let *AB* be the major or longer axis and *CD* the minor or shorter axis. Place these axes at right angles at their centers, marking the intersection *O*. Using the distance *AO* as a radius, place one leg of the compass at *D*, and cut the points *E* and *F* upon the major axis. These points will be the foci. Place a pin at *E* and another at *F*; tie the end of a string to *E*; stand a pencil at *C*; run the string around the pencil at *C*; then carry the string to *F* and fasten. Now run the pencil around, keeping the loop of the string on the pencil while drawing the required ellipse.

SCHOOL AND OFFICE FURNITURE.

NOTE.—The following specifications are given in English units instead of metric. This is in accordance with Act No. 1843. The drawings and finished dimensions are to be in decimal parts of a meter. In each case the finished dimensions (metric) are given so as to agree with the requirements of the mechanical drawing course.

The illustrations from 172 to 184, inclusive, are taken from furniture manufactured in the Iloilo Trade School. These designs are the results of numerous experiments in the "commercial" department of the school extending over a period of four years. The main object has been to produce strong, serviceable articles at a moderate price, with the elimination of unnecessary details and waste material.

FIGS. 172–174.—*School desks.*

Dimensions of fig. 172: Height, 0.762; length, 0.915; width of parts mentioned below.

Much time and labor can be saved and the results of the commercial work greatly augmented by a proper selection and storing of supplies. This is most noticeable in the manufacture of school desks (figs. 172 to 174), which will be described in detail, owing to the fact that there is great need of school desks in nearly all of the provinces and that this need should be supplied by the trade schools. In this way the people of the municipalities get more school desks for their money and also help to pay the living expenses of some of their boys who may be in the school. In order to secure the best results, tangili should be used. This is well sorted at the mill and is free from knots, checks, and heart cracks, so that there is very little waste; and it is almost as easy to work as American pine. It also resists decay and white ants much better than any kind of lauan. This should be ordered about six months in advance, so as to allow

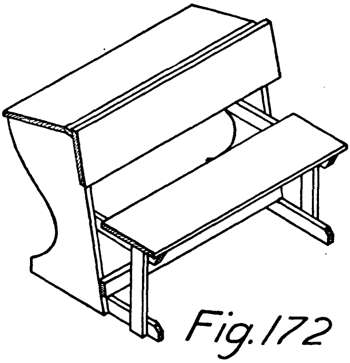


Fig. 172

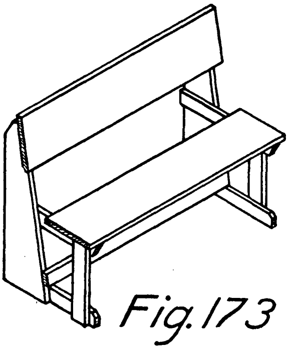


Fig. 173

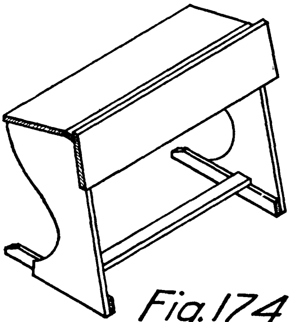


Fig. 174

for several months storage "on sticks" (with separators) in a dry place. Different widths should be stored in separate piles. In making up an order for lumber, it is usually more satisfactory to the lumber company, as well as to the teacher, to request lumber of various widths (see sample order below). Very much of the school furniture can be made almost entirely of inch stuff. This is the standard size among lumber dealers here as well as in the States. Inch boards can be resawed at the mill, or by hand sawyers in any part of the Islands, so as to make panel stuff; 2- and 3-inch planks can be resawed as needed for square or oblong pieces to make legs, braces, rails, etc. If the lumber is fairly well seasoned and the planer knives kept sharp, well balanced, and evenly set, the only operations needed to make school desks will be cutting off, sawing curves, planing edges, sandpapering, and nailing together.

The following is a sample order of tangili to be used in the manufacture of 1,000 school desks, complete:

5,000 bd. ft. 1″ by 12″ in short lengths, to cut 32″ pieces.
5,200 bd. ft. 1″ by 10″ in short lengths, to cut 36″ pieces.
2,100 bd. ft. 1″ by 8″ in short lengths, to cut 36″ pieces.
1,700 bd. ft. 1″ by 8″ in short lengths, to cut 30″ pieces.
1,500 bd. ft. 1″ by 3″ any length.

The cost should be about ₱700 to ₱1,200.

Lumber is usually cut in lengths of 6, 8, 10, 12, 14, . . . 24 feet at the mill, and, on account of the longer sizes being used more in building construction, the short pieces are sold at a much lower rate. These can be used in furniture construction without much waste, if the lengths desired are specified as in the sample order above; allowance has been made for waste of about 5 to 10 per cent. The 1 by 12 pieces are for the two sides; the 1 by 10 pieces are for the top and seat; the 1 by 8 (36″) are for the backs; the 1 by 8 (30″) are for the shelves; and the 1 by 3 pieces are for the braces and top strip. The curved piece cut from the side may be ripped to 3 inches and utilized as a seat brace, the lower curve coming under the front of the seat. The shelf may be made of 1 by 8 material, and will help to brace the desk if nailed from the outside. The top, back, and seat project about 2 or 3 inches. The top strip should slant forward a very little.

All the nails should be 2½″ common, medium size. Waste of nails may be prevented by using the same number of nails for each desk and requiring pupils to account for any that are used in excess of the regular amount. The following arrangement of nails has given good results: (For one side) top, 3; top-strip, 1; back, 3; seat, 3; seat brace, 2 or 3 back and 2 front; bottom brace, 3 back and 2 front; cross brace, 2; shelf, 2 or 3. If the nail farthest back in the bottom brace splits the wood, a finishing nail may be used or the curve may be cut higher. Nails that extend through two pieces should be driven from the outside and clinched on the inside (with the grain).

These desks should be made "K. D." ("knock down," or not put together), except the two sides, thus facilitating both storage and transportation. Students receive 10 centavos per desk for setting them up in the municipalities, and 45 to 50 centavos for making the desk. The total cost of each desk, including 20 per cent for expenses, use of machinery, etc., should not be very much above ₱2.

In some provinces, these desks are finished with linseed oil (boiled) ; but it is not essential and also makes the cost higher. If linseed oil is used on furniture, it should be rubbed on with an old cloth, allowed to soak in for about a half day, and then the furniture rubbed quite dry with an old cloth. Do not use cotton waste.

FIG. 175.—*Teacher's table* (*"Barrio table"*).

This table is the usual height (0.762) with a top 2 by 3 feet (0.61 by 0.915) and legs made of 3″ by 3″ squared stuff. The rails are 5 or 6 inches wide and mortised into the legs. The top may be made of two pieces (12″ stuff) fastened together with dowels and white glue. Owing to the necessary planing of the edges, the top may be slightly less than 24″ wide. It should be fastened with about 6 finishing nails ($2\frac{1}{2}$″) in each end and 2 in each side. These may be sunk below the surface and covered with colored putty to correspond with the color of the wood when finished. Linseed oil, rubbed, is a good finish. (See 172.)

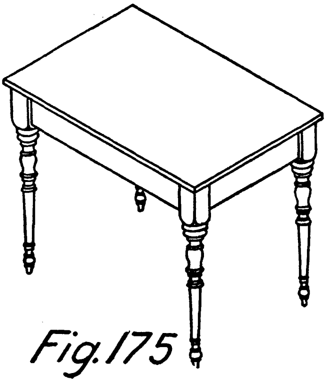


Fig. 175

FIG. 176.—*Blackboard frame.*

The strips for this may be cut from a 2″ or 3″ plank. The joints should be carefully made and put together with screws. This is made to fit the standard "hyloplate" blackboard, and the groove should allow 0.001 or 0.002.

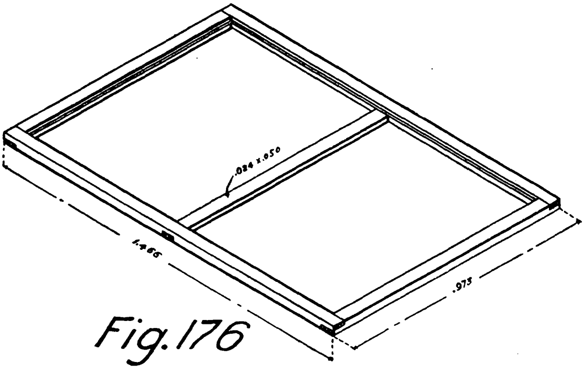


Fig. 176

If desired, a cheaper frame may be made from inch stuff, planed, 2″ wide, with a ledge groove at the back, into which the hyloplate is nailed. The corners are mitered and fastened by strips of galvanized iron or sheet brass (14 or 16 gauge), nailed over the ends.

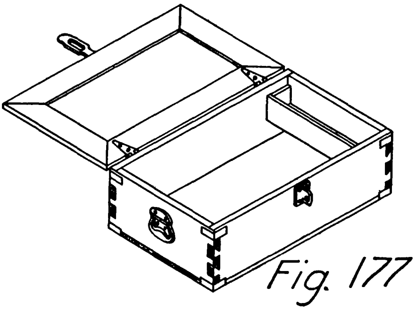
FIG. 177.—*Trunk or chest* (*Constabulary design*).

This has been a very popular design, about 1,500 of these chests having been made in the Iloilo Trade School.

Dimensions (outside), 0.305 by 0.406 by 0.66.

Lumber: Tangili, planed to ¾″. The sides and top (overlaid panel) can be made of 12″ stuff; the bottom can be made of two pieces (8″ and 9″) joined with a half lap groove. Dovetails should be carefully made; a 2½″ finishing nail or slender screw may be put in the four exposed tenons of the end pieces (they will not hold so well if they are put in the side pieces).

The top-frame should be carefully joined with a miter and mortise joint, glued and nailed, so as to withstand the strain of several boxes in a pile. The overlaid panel (⅜″) should be fastened with 2½″ finishing nails clinched on the inside. The bottom of the box should be fastened with 2½″ common nails. The small tray may be made of ½″ or ⅝″ stuff and nailed in place.



Hasps and hinges: Galvanized iron, strap, the inner part fastened with screws and the outer part with rivets (copper preferred, 1″ or 1⅛″). If the entire hinge is outside, the top must be bent to fit the lid of the box, and should be fastened with one long screw and two rivets. The reason for using rivets should be apparent. The hasp should also be put on with rivets, but this is unnecessary for the staple. An ideal arrangement would be to have the staple pass through the wood and clinch on the inside. The handles may be of galvanized iron or japanned iron. The brass bindings are cut from "Muntz metal" (sheet brass) No. 14 or 16 gauge, polished, and fastened with round-head brass brads, 12 for each.

Finish: Linseed oil, rubbed. (See 172.)

These trunks can be made to sell for ₱4.50 to ₱5, depending upon various conditions. Labor should cost ₱1.25 each. If these are made with a one-piece top, raised panel, the labor should cost ₱1 each.

FIG. 178.—*"Barrio trunk."*

This is intended to hold the books, etc., of a barrio class, and should be made as simple and cheap as possible.

Dimensions: 0.254 by 0.305 by 0.864.

Lumber: Tangili, inch stuff, S 2 S (surfaced on two sides), sandpapered and put together with plain butt joints, using 2½″ common nails.

Hasp: Galvanized iron.

Hinges: Butt, iron or brass. Brass corners same as in fig. 177.

Finish: Sandpaper, plain or oiled. (See 172.)

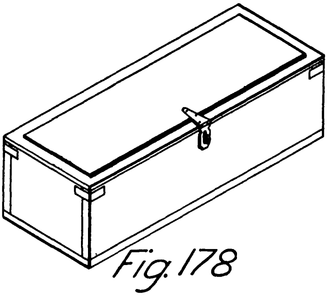
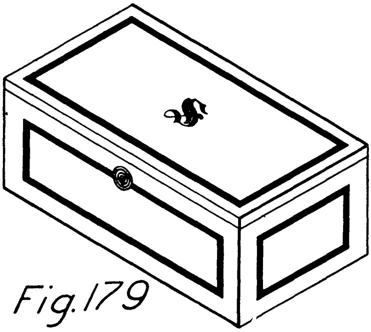


FIG. 179.—*Jewel or cigar box.*

Dimensions: 0.10 by 0.15 by 0.30.

This is made of molave, inlaid with strips of ebony or camagon, and having the initial or monogram of the purchaser inlaid in the top. The molave should be very dry and well seasoned. The sides are mitered, glued, and nailed from the groove that holds the ebony (concealed nails). The bottom is fitted into a ledge groove and nailed from below.



Hinges: Brass butt.

Lock: Yale, chest (very small), brass.

Finish: Wax, shellac, or varnish.

FIG. 180.—*Teacher's desk.*

Dimensions: Top, 0.61 by 0.915; height, 0.762.

This has been very popular among all classes of people and is especially attractive when the top is made of one piece and neatly finished.

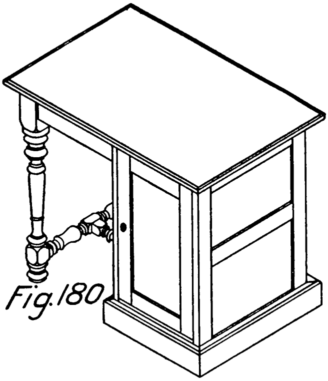


Fig. 180

Lumber: Tangili, narra, amuguis, or any medium grade. Panels, ½-inch stuff S 2 S; legs, 3 by 3, squared and turned; braces, 2 by 2, squared and turned; top, rails, and framing pieces inch stuff, S 2 S. Interior shelves, optional.

Lock: Yale, or Y. & T., brass, cupboard.

Finish: Oil (see 172), wax, or varnish.

FIG. 181.—*Inlaid table.*

Dimensions: 30″ to 36″, square top, one piece; ipil or

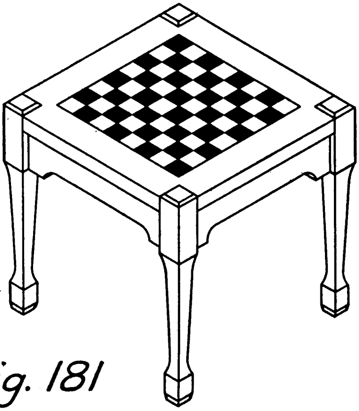


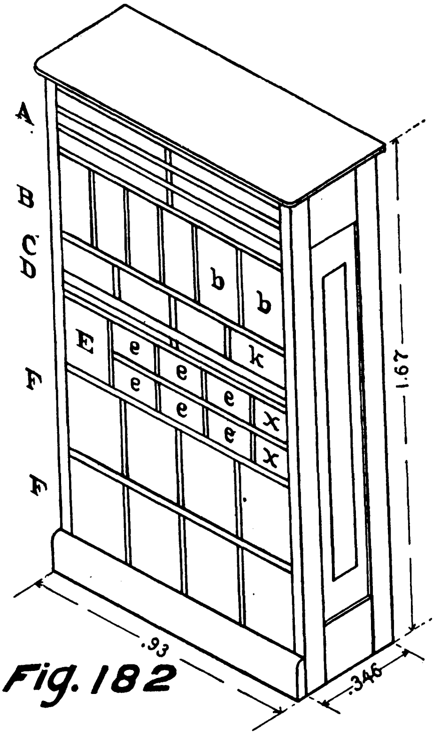
Fig. 181

other hard wood, 1½″ to 2″ thick, inlaid as a chess board or checker board with alternate squares of ebony or camagon and molave. Legs and rails same material as top. Rails inserted 1″ (no tenons) into legs and fastened with angle irons and screws inside (K D style). Top of legs to fit corresponding notch in corner of table *accurately,* projecting above about ⅛″ with long bevel. Legs should be massive, 3½″ or 4″ square, and tapering gracefully toward base. Bevel at base, about 45 degrees. Rails 1¼″ thick and 6″ wide at ends.

Finish: Wax, shellac, or varnish.

FIG. 182.—*Filing case for trade schools.*

Dimensions: 0.346 by 0.93 by 1.67.
Material: Tangili or lauan.



This is designed to accommodate the forms of the new accounting system for trade schools.

All spaces are to be fitted with drawers; "B," "b," and "F" having label plates and drawer pulls, and the small drawers having label plates only; for the small drawers the label plates should have finger pulls. The shelves, fronts of drawers, top and base boards are to be made of inch stuff, S 2 S. Side frames and middle support at "D," 1½″ by 3″, S 2 S. Panels, partitions, and boxes ½″, S 2 S. Supports for shelves ½″ by 2″ (exact), mortised into side frame and flush with inner surface. Partitions to be inserted from the back into grooves extending nearly to front edge of shelves. Back ½″, S 2 S, fitted with ledge groove (half-lap) or tongue and groove. Sides of drawers attached to front with lap butt joint, nailed.

Finish: Sandpaper and oil. (See 172.)

A.—Blank forms.
B.—Correspondence and documents.
b.—Property cards. (P. F. 130.)
C.—Equipment cards. (P. F. 117.)
k.—Keys in small envelopes.
D.—Sliding shelves.
E.—Property cards. (B. E. Form 100.)
e.—Student record cards.
x.—Index record or miscellaneous.
F.—Job cards. (P. F. 131.)

FIG. 183.—*Storage bookcase* (large size).

Dimensions: 0.635 by 1.56 by 1.88.

This may seem to be too large, but experience has proved it to be very useful in municipalities or division offices having large quantities of books, etc., that need to be protected from insects and dampness. A smaller size is usually furnished to the smaller towns.

Material: Tangili, apitong, amuguis, or any medium grade of wood.

Shelves, top, top decoration, base board, and door frames, of inch stuff, S 2 S. Panels and back, ½″ or ⅝″, S 2 S. Side frames, 1½″ by 2¾″ (exact); this includes the cross-pieces which serve not only to hold the panels, but also as supports, the shelves being nailed to them, thus making the case much stronger. The vertical frame pieces must rest on the floor. The back boards should be fitted with half lap or tongue and groove; the boards must extend to the floor and be nailed to each shelf. The shelves are supported in front by a piece (⅞″ by 2½″) set into, and nailed to, each shelf with 2 nails (2½″ com.), and extending from the top board to the floor. The doors close over this, the left one being fastened to it with two hooks and eyes, and the right one having a large cupboard lock (Yale, brass), or a hasp and padlock (Yale). A piece of molding (⅜″ by

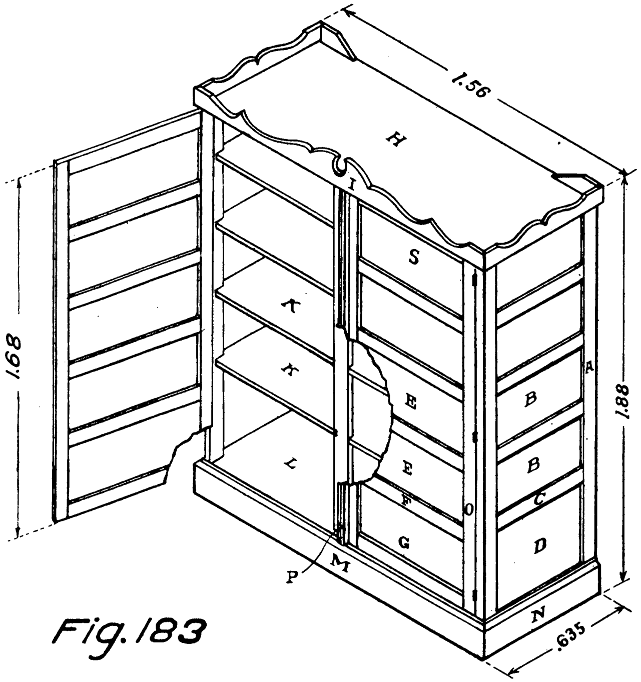


Fig. 183

$\frac{3}{4}''$) made with a hand beader should be nailed to the door at the right, so as to cover the crack between the doors and also prevent insects from entering. The severity of outline may be reduced by fluting the four main uprights with a hand beader, and also by the use of harmonious curves in the top decoration. A small turned object is usually inserted in the circular opening at the top. The panels should be flat, and, if a bevel is necessary to make the panel fit tightly, it should be very slight, so as not to be noticeable. The grooves for the lower panel are $\frac{1}{2}''$ and for the others $\frac{3}{8}''$.

Hinges: 3 on each door, brass or iron.

Finish: Sandpaper and oil. (See 172.)

FIG. 184.—*Field Desk* (for supervising teachers).

Dimensions: 0.311 by 0.737 by 0.965.

In order to secure uniformity among supervising teachers in filing official papers and blank forms, the design for this field desk was prepared under the supervision of the Second Assistant Director of Education. Desks made from this design have been in use one year and give good results.

The following letters, corresponding to those in the illustration, indicate the use of each drawer or pigeonhole (A, B, C, D, E, F, and G are spaces for drawers):

A and *B*.—Document file.
C and *D*.—Pencils, stamps, clips, rubber bands, etc.
E and *F*.—Pupils' and teachers' cards.
G.—Form 100.
H.—Circulars.
I.—Inkstand, pen and pencil rack, etc.
e, e, e, f.—Blank forms and Form 101.
g, g.—Writing paper.
i, i, i. . . . .—Envelopes, temporary filing, etc.
n.—Blotters.
r.—Blotting sheet.

A table is usually made to accompany this with a top 3′ by 5′.

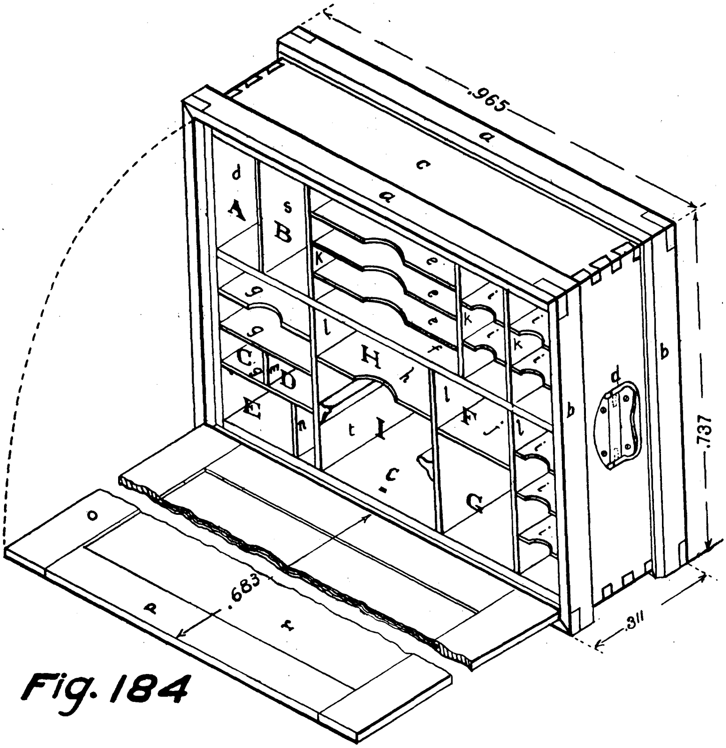


Fig. 184

SPECIFICATIONS.

The entire desk may be made of hard wood if desired, but a saving of weight, expense, and time may be effected by making the sides and lid of hard wood, such as narra, ipil, banuyo, and the inside pieces and back of softer wood, such as tangili, calantas, or lauan. The hasp and hinges should be "strap" style, of galvanized iron, extra strong, and fastened with copper rivets in the exposed parts. Three hinges are necessary. Handles: Cast or wrought iron, heavy, galvanized. Corners: Iron, 0.002 or 0.003 thick, galvanized or painted black, put on with screws. Padlock: Yale. The frame and panel for the lid should be carefully made of well-seasoned material, and accurately fitted. The through mortise and tenon may be used, but the "foxtail" (blind) mortise and tenon gives a better appearance. The lid closes flush with the side strips and should rest against the edges of the box frame, shelves, and partitions. The partitions and shelves are inserted from the back in grooves that extend nearly to the front (0.01), and the back is fastened with screws or nails. Back boards to be joined with ledge groove. Finish: Sandpaper and oil. (See fig. 172.)

BILL OF MATERIALS (Fig. 184).

[Taken from Job Card No. 412.]

MATERIALS USED.

18 bd. ft. ipil, planed.
46 bd. ft. tangili, planed.
6½ bd. ft. banuyo, planed.
10 finishing nails, 2½".
50 common nails, 1".
210 common nails, ¾".
3 sheets sandpaper.
21 screws, bright, 1½", No. 10.
27 screws, bright, 1", No. 6.
8 screws, bright, ⅞", No. 12.
4 screws, bright, ¾", No. 10.
14 screws, bright, ¾", No. 8.
48 screws, bright, ¾", No. 6.
18 screws, bright, ¾", No. 4.
1 pair chest handles, japanned.
3 hinges, strap, iron, 0.0762.
1 hasp, strap, iron, 0.0762.
7 brass flush rings, ¼", No. 35.
9 rivets with burrs, copper, 1", No. 8.
8 iron corners.
1 pint linseed oil.
1 padlock, Yale.
Glue.

COST.

Materials	₱12.259
Labor	12.00
Total	₱24.259

(20 per cent should be added to the total cost.)

NOTE.—In the construction of this desk all shelves should have the grain running lengthwise of the box, and partitions should have it running vertically. This will provide for a uniform contraction or expansion of all parts. The carpenter will observe that the longest dimension of each part is given as the length irrespective of the direction in which the grain runs.

FINISHED DIMENSIONS OF PARTS (Fig. 184).

1 Location of part.	2 Thickness.	3 Width.	4 Length.	5 Number of pieces.
a	0.022	0.073	0.965	4
b	.022	.073	.736	4
c	.022	.273	.920	2
d	.022	.273	.692	2
e	.009	.273	.378	3
f	.019	.273	.886	1
g	.009	.241	.273	3
h	.009	.273	.322	1
i	.009	.119	.273	7
j	.009	.194	.273	1
k	.016	.273	.270	3
l	.016	.273	.378	3
m	.009	.082	.273	1
n	.009	.136	.273	1
o	.022	.102	.692	2
p	.022	.102	.787	2
r	.019	.514	.699	1
s	.009	.273	.270	1
t	.030	.040	.273	2
Back of desk	.016	.692	.920	1
A & B.[a]				
Front	.012	.116	.260	2
Sides	.006	.254	.270	4
Back	0.006	0.098	0.254	2
Bottom	.006	.116	.270	2
Partitions	.006	.103	.254	2
C & D.[a]				
Front	.012	.098	.116	2
Sides	.006	.063	.270	4
Back	.006	.063	.098	2
Bottom	.006	.116	.270	2
E & F.[a]				
Front	.012	.127	.184	2
Sides	.006	.117	.270	4
Back	.006	.117	.167	2
Bottom	.006	.184	.270	2
Partitions	.006	.120	.171	2
G.[a]				
Front	.012	.184	.232	1
Sides	.006	.225	.270	2
Back	.006	.171	.222	1
Bottom	.006	.184	.270	1
Partitions	.006	.178	.222	3

[a] Capitals represent drawers.

NOTE.—(*a*) and (*b*) project over (*c*) and (*d*) 0.016, or flush with the back which is fastened to (*c*) and (*d*). (*r*) should be a raised panel facing outside and should have sufficient allowance inside for the blotting sheet.

FIG. 185.—*Office desk.*

Dimensions: 0.737 by 0.806 by 1.37.

This is a single desk; that is, having drawers in front only; however, the same model may be used for a double desk by making the top slightly larger.

Material: Narra preferred, although it may be made in any kind of wood and finish to suit the purchaser.

Top: $\frac{3}{4}''$ carefully joined with dowels and white glue. Four cleats, to hold the drawer sections in place, may be attached to the top with round-head screws in slots to allow for expansion and contraction of the top during the various changes of seasons. Edges of top to be rounded (above only) or shaped with molding planes.

All frame pieces, baseboards, drawer fronts and the connecting brace below are made of inch stuff, S 2 S; panels of $\frac{1}{2}''$ stuff, S 2 S, raised; draw pulls of wood, fastened by screws from inside of drawer; interior woodwork, tangili or lauan; sides of drawers fastened by lap butt joint, nailed, or by dovetails if preferred.

Locks: Y. & T., brass, number optional.

Finish: A rubbed finish (shellac preferred) may be put on the top, and varnish on the sides. An additional coat of wax polish over the top will prevent the varnish from becoming sticky.

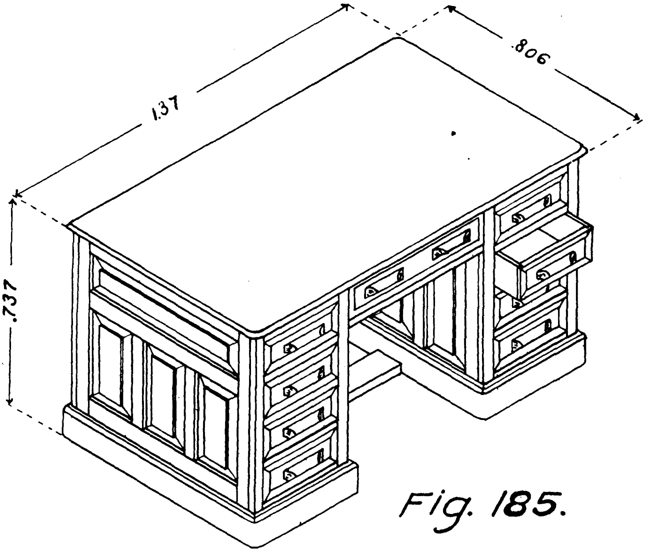
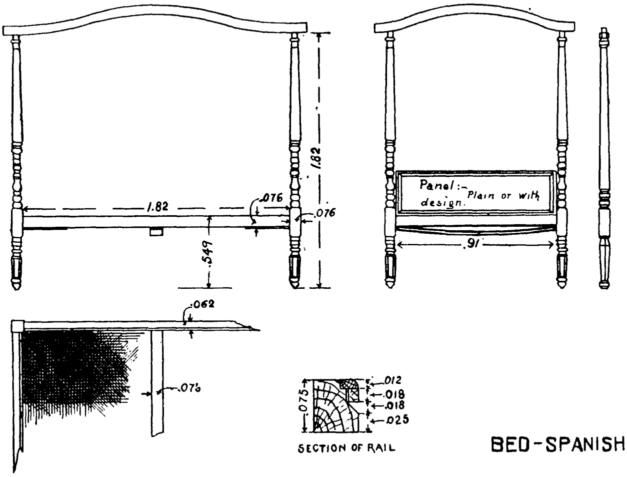
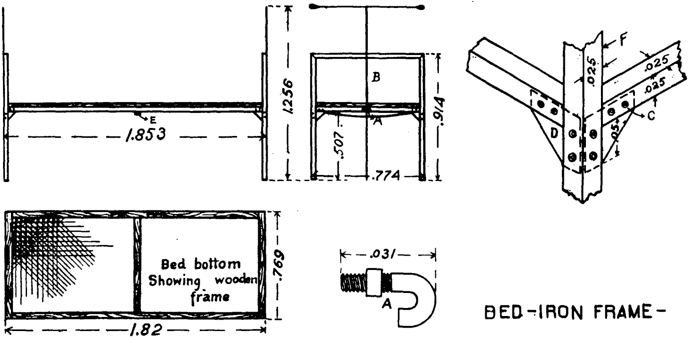


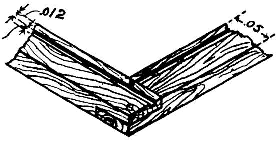
Fig. 185.



BED-SPANISH STYLE-



BED-IRON FRAME-



A.-Clamp for holding rod.
B.-.006 diam. with cross arm for holding mosquito bar.
C.- Rivet .006 diam.
D.- Brace made of the same material as frame.
E.-Wood cross bar sprung at center.
F.-Frame: angle iron .003 thick.

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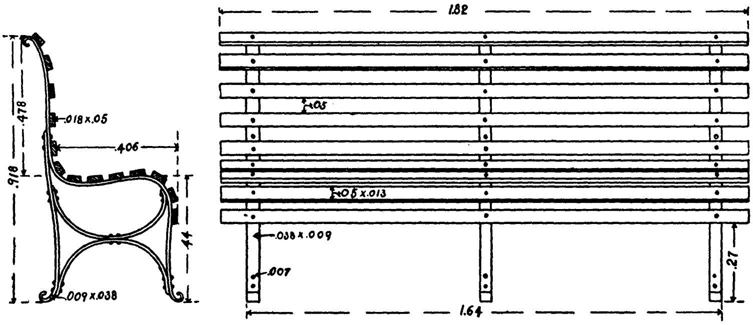
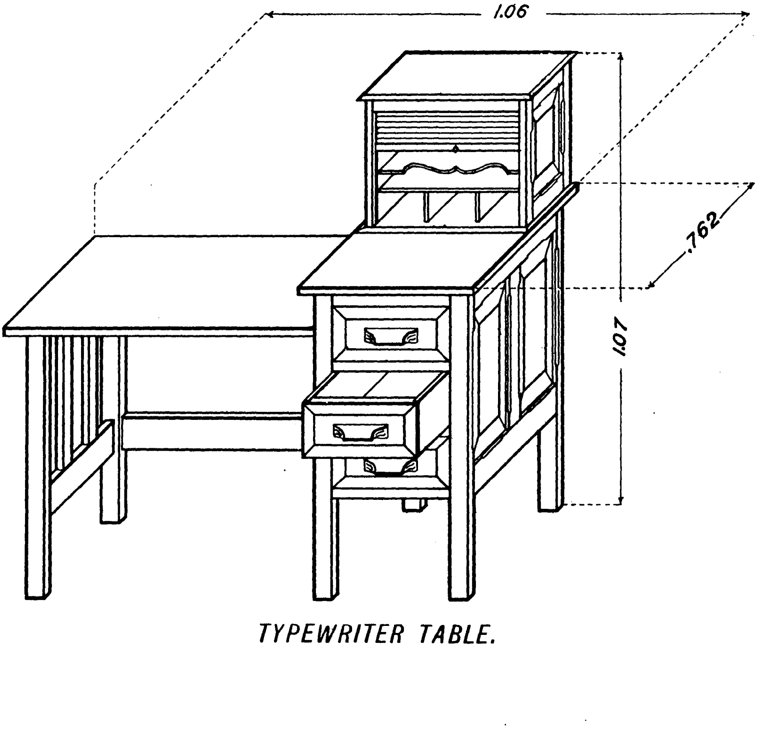
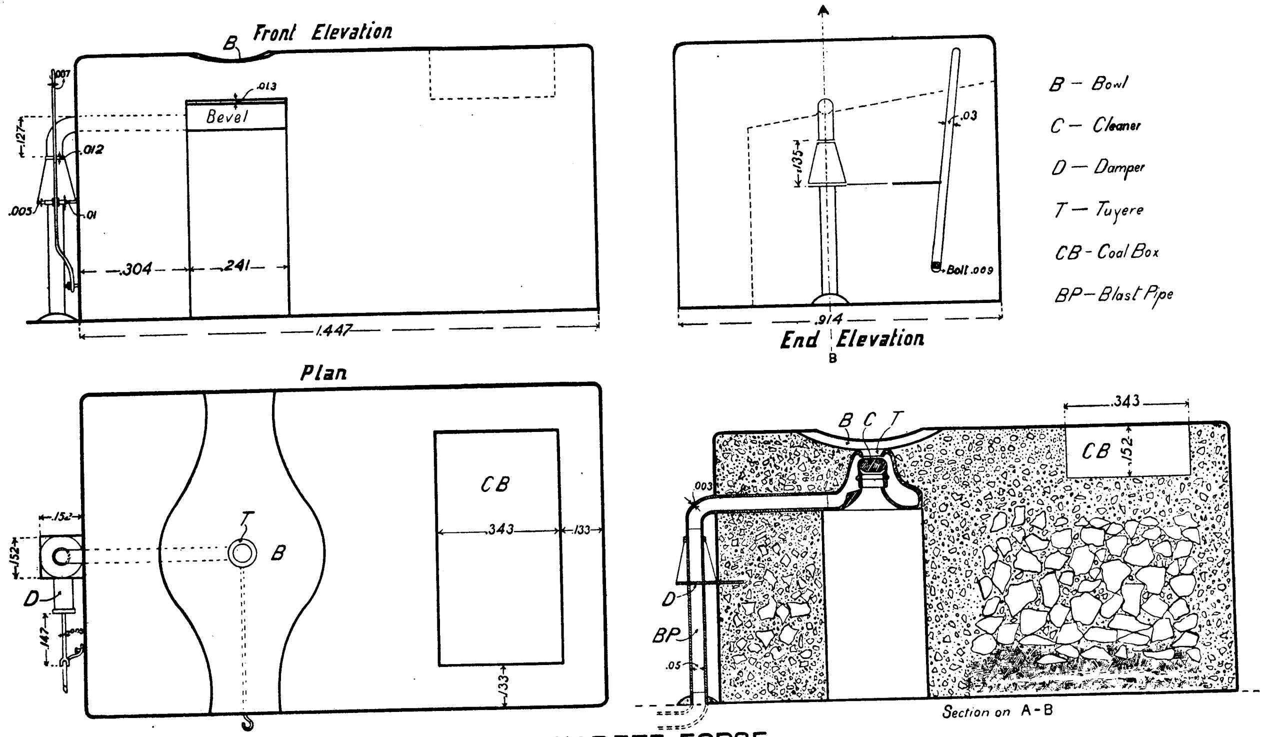


SETTEE

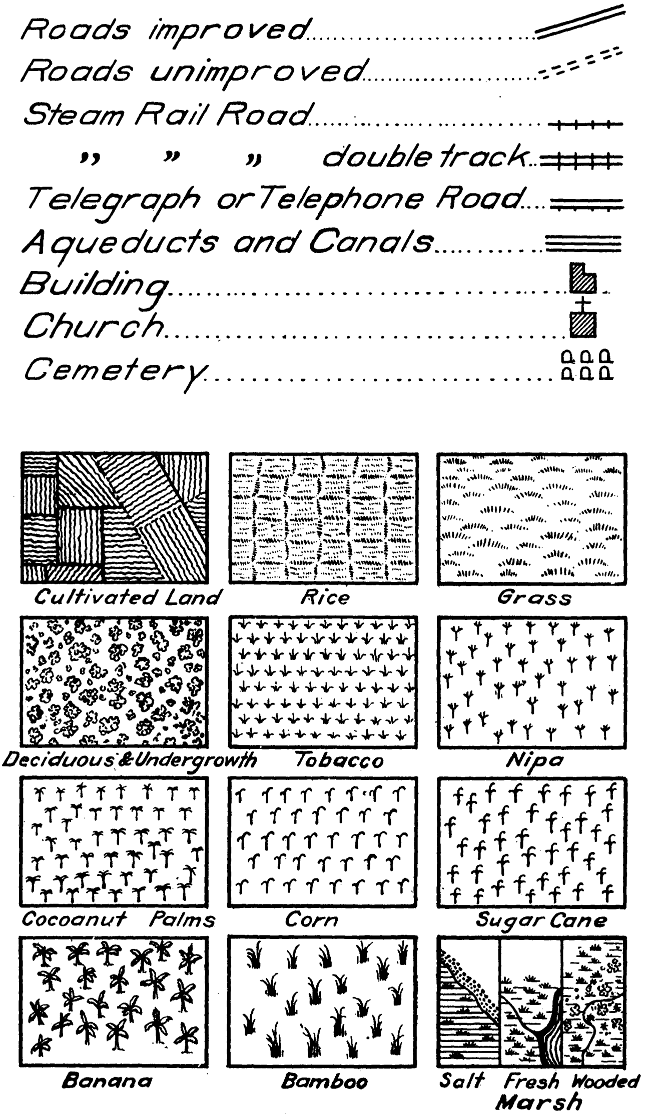


TYPEWRITER TABLE.



A CONCRETE FORGE

SYMBOLS FOR INSULAR MAP WORK



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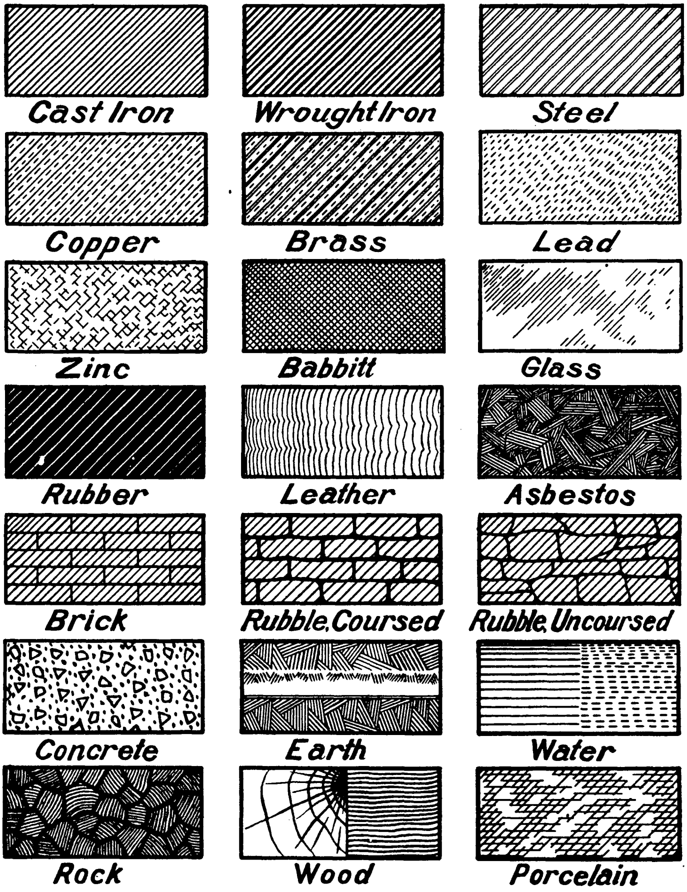
STANDARD CROSS SECTIONS



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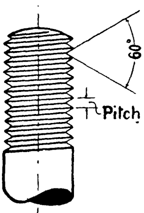
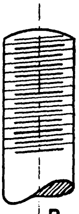
METHODS.

The figures on this page are intended to illustrate some of the general methods used in drawing.

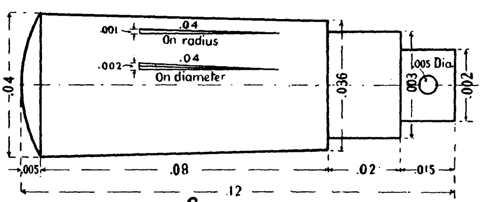
Fig. A shows the "accurate method" of representing bolt threads. In the design of a bolt thread the points both at the top and the bottom are cut off; however, in working drawings, the thread is drawn to a point, both at the top and bottom, the angle measuring 60 degrees, as illustrated.



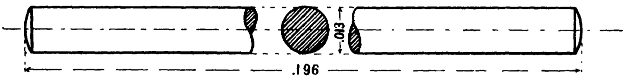
A



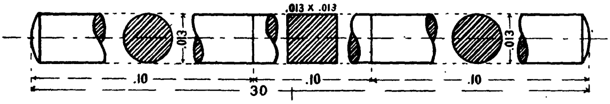
B



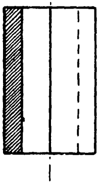
C



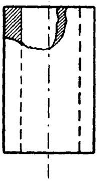
D



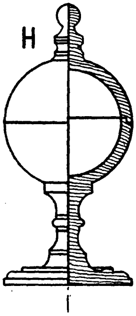
E



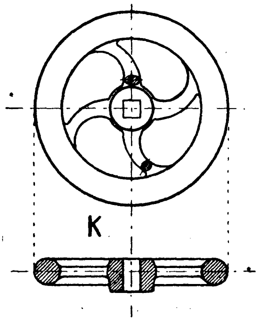
F



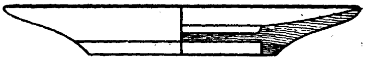
G



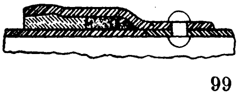
H



K



J



L

By the term "pitch" is meant the distance from the center of one thread to the center of the next, measured parallel to the axis of the bolt.

Fig. B shows the "conventional method" of representing bolt threads.

The radius of the curve at the ends of the bolts in figs. A and B should be equal to the diameter of the bolt.

Fig. C shows a good method of dimensioning a tapered piece in which absolute accuracy is essential. The taper may be expressed either as a ratio of the radius and length or as a ratio of the diameter and length.

Figs. D and E represent drawings of bars. By omitting a part of the drawing near the center of a uniform portion of the bar the drawing may be shortened, thus saving considerable space.

Figs. F, G, H, and J show methods of sectioning symmetrical objects. It will be observed that by making a quarter section of such objects considerable space and time may be saved.

Fig. K shows the method of representing a wheel. It will be observed that the line of section passes through the arms of the wheel; however, the arms are not sectioned, but are drawn in full. The arms contain cross sections drawn at such points as will serve to illustrate with exactness the cross sections desired.

Fig. L shows a part section of a wrought-iron pipe joint.

By examining some of the house plans in this manual it will be seen that some of the doors and windows are shown on plans by heavy black lines. Sections of window glass are represented by similar lines. This method is proper in drawings made to a small scale or in drawings where these particular portions are again represented in detail.

By examining the cross section of the septic vault in this manual it will be seen that the cross lining is the same as that used for cast-iron. It should be remembered that this sectioning is not only used for cast-iron but also for general purposes where there is no need of representing in detail the various materials exposed by the section.

BLUE PRINTING.

In order to obtain the best results all unnecessary exposure of either the sensitized paper or the sensitizing solution to the sunlight or other white light should be avoided.

Cleanliness is of great importance. The dishes or vessels in which the chemicals are prepared and kept should be very clean. After using they should be washed thoroughly with clean water. Never permit the chemicals to come into contact with iron. The chemicals can be dissolved in the usual manner, but when "A" and "B" are mixed and applied to the paper it should be done in a dark room having red or dark yellow glass, or a small candle 1 or 2 meters from the paper.

Prepare solutions as follows:

STOCK SOLUTION "A."

Ferrocyanide of potassium (Red prussiate of potash)	29.16	grams.
Water	120.	cc. (4 oz.)

STOCK SOLUTION "B."

Citrate of iron and ammonia	19.5	grams.
Water	120.	cc. (4 oz.)

For use, mix equal parts of solutions "A" and "B." This will be the sensitizing solution and when once mixed should be kept in a cool and absolutely dark place. When the color changes to a bluish green the mixture is no longer fit for use and should be rejected.

On account of the fact that bad results are obtained from using old solutions, the foregoing formulas provide for only a small quantity, 240 cc. (8 oz.), when "A" and "B"' are mixed. This is enough to coat 2.32 square meters (25 square feet) of paper, or about eight full sheets for the printing frame, which is 0.50 m. by 0.60 (20″ by 24″).

Arrangements have been made whereby these chemicals can be obtained from the Bureau of Supply, put up in small wide-mouth bottles. Four bottles of each would supply an ordinary school for six months or a year. A "graduate" of 120 cc. should be purchased with the first order. Schools doing a large amount of blue printing should order the chemicals in original packages. (490 grams or 1-pound bottles.)

The plate glass for the printing frame is .0056 m. (nearly ¼″) thick, and can be obtained in Manila for about ₱6.

The unprepared paper can be obtained in rolls from the Bureau of Supply as follows:

Thin paper, .91 m. (36″) wide, 45.50 m. (50-yard) rolls.

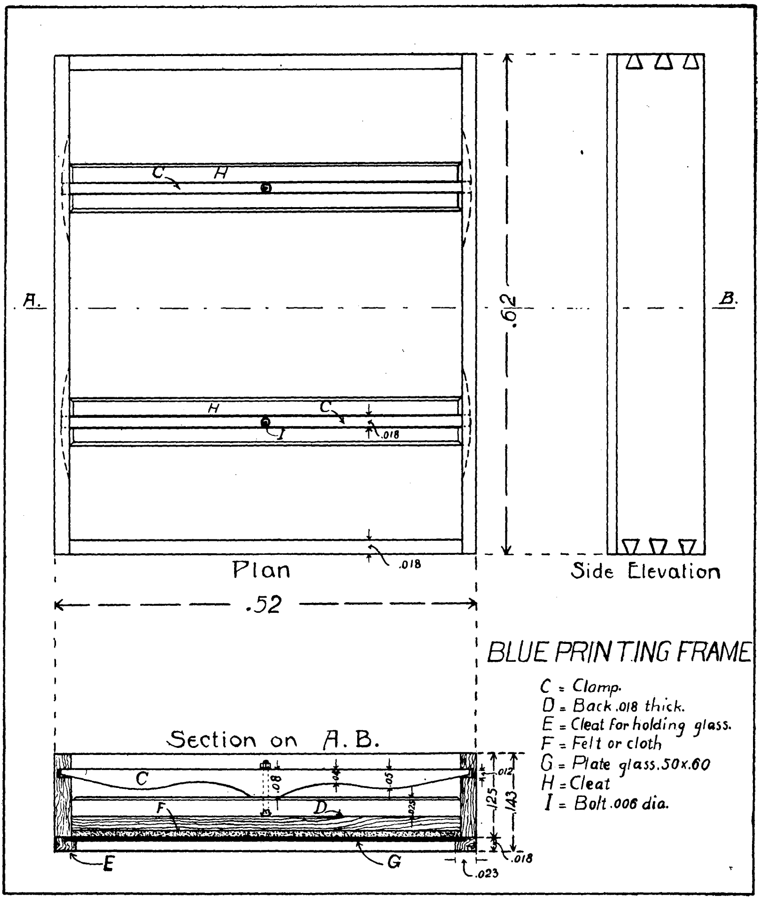
Thick paper, .91 m. (36″) wide, 45.50 m. (50-yard) rolls. (This is the better for shop blue prints.)

The cost of this paper will be about ₱3 per roll.

The solution may be applied as follows:

Lay the sheet of paper upon a board; pour the solution into a dish; then, using a soft, wide brush (free from iron) dipped into the solution, go over the paper rapidly, applying the solution by making strokes in the direction of the length of the paper; then, immediately go over the paper again with the brush squeezed out, making strokes at right angles to these so that the solution may be uniformly and thinly distributed over the entire surface; wash out the brush and hang the paper up to dry in a dark room. The board should be wiped off after each sheet has been prepared in order that the back of the next sheet will not be smeared. If the board is covered with a piece of oilcloth the wiping may be done more easily. The color of the solution on the paper should be light yellow. The paper must be perfectly dry before it is used or put away. It should be kept in a dark, dry place. When the color on the paper changes to a bluish green the paper usually will not produce the best results, for the solution on it has become too old. Such paper may be again prepared for use by coating on the reverse side.

To make prints, the paper is placed beneath the tracing under a glass and exposed to the sun. The glass should be of sufficient strength to insure a close contact between the tracing and the sensitized paper. (See drawing of printing frame.) The face of the glass should be placed perpendiculary to the rays of the sun. If not so placed the edge of the frame may cause a shadow to fall upon the edge of the tracing, thus producing a poor print.



Care should be taken not to heat up the glass too suddenly in the hot sun, especially if the frame is damp or cool, as this may cause the glass to crack. The time of exposure will depend upon the intensity of the light and upon the quality of the paper; on a bright day it may be from one to five minutes; on a cloudy day it may be from ten to thirty minutes; this can only be determined definitely by trial. By watching the edge of the paper protruding from beneath the tracing it may be seen that this will turn to a green color, then to blue, and finally to a gray color. It will usually be found that the length of exposure is sufficient when the color of this edge of the paper commences to become gray.

After the paper has been exposed to the light it should be washed thoroughly in clean water, running water if possible, until the lines appear white; it should then be hung up to dry.

If not washed enough the lines may turn to a light blue color after drying; also, if the paper has been exposed to the light before printing, the lines may not wash out white. Fairly good prints may be made from old paper (if not too old) by giving a short exposure and a long washing.

Usually, the fresher the paper is, the longer the exposure and the less the washing required; while the older the paper, the shorter the exposure and the longer the washing required. White lines may be made upon blue prints by using a pen dipped into Chinese white or a solution of water and common soda.

If these instructions are followed carefully, any trade school will be able to make first class blue prints. These are absolutely necessary in shopwork, and also very useful in other lines of work.

SEPTIC VAULT.

The following plans and specifications were furnished by the Bureau of Health, Manila.

Vault to be of dimensions, shape, and design shown in drawing and to consist of four main walls (AB, BD, DC, and CA), a division wall (FF), and a bottom to receiving vault (CF) of concrete or other suitable masonry, a bottom (NN) for filter vault of loose broken stone or gravel, and a concrete top (WWW) laid on joists (VVV).

Inside walls of both filter and receiving vaults and bottom of receiving vault to be provided with a layer of cement mortar.

The filter vault to be provided with a stone or concrete partition wall (MM) with vents and opening as shown, and to be filled with broken stone or gravel.

Provide three cast-iron or hard-wood trapdoors, one for receiving vault and two for filter vault, as shown.

Wastes to enter receiving vault through a cast-iron waste pipe (SS); overflow from receiving vault to enter filter vault through a cast-iron 90-degree bend (EE).

Surplus water from filter vault to enter street gutter, river, estero, or street sewer through a discharge pipe (KK).

Bottom or receiving vault (CF) to be at least 1 meter below level of bottom of discharging pipe (KK).

Ventilation tubes (RR) to be placed in division walls (FF) and (MM) as shown.

Concrete to be composed of 1 part pipe Portland cement, 2½ parts clean sand, and 5 parts of gravel or stone broken small enough to pass through a 5-centimeter ring.

The Portland cement to be one of the standard brands in general use in Manila, or of a quality equally as good, and which shall be satisfactory to the city engineer and the Bureau of Health.

Sand to be cleaned of all mud, loam, ooze, salt, and other impurities by washing in fresh water.

The cement, sand, and broken stone to be mixed while dry. Enough water shall be used to wet throughly the different ingredients.

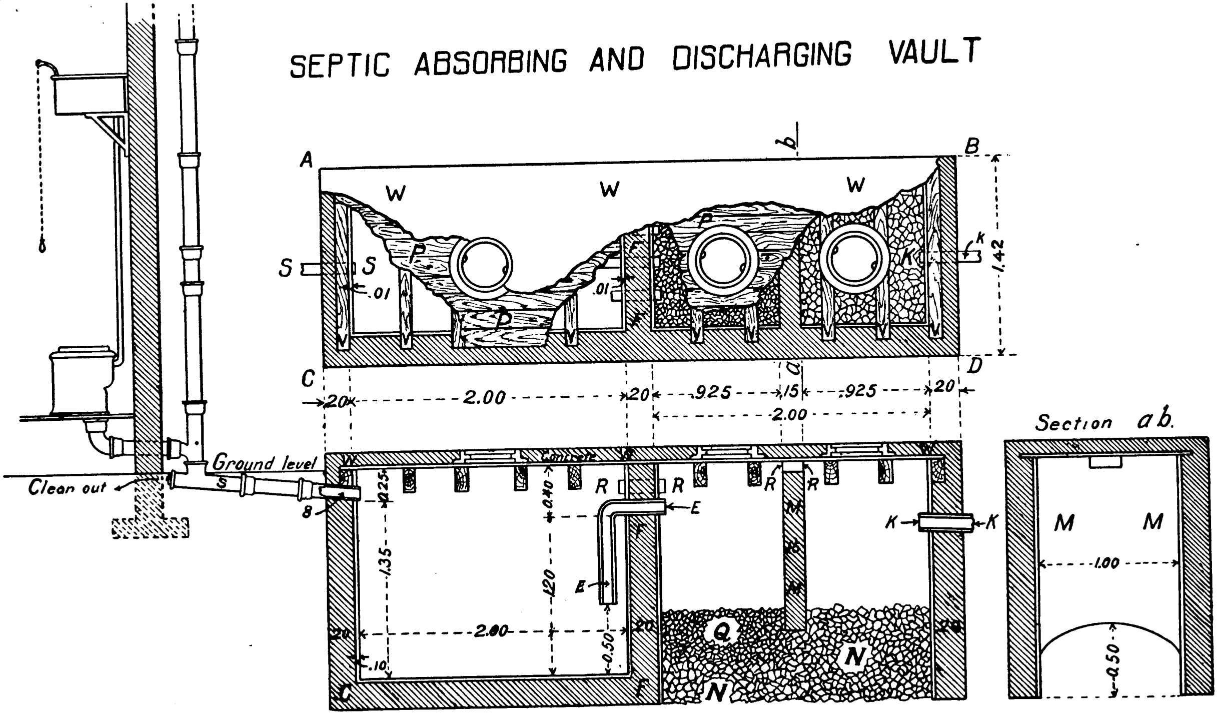
The concrete to be mixed only in small quantities and each batch to be placed as soon as mixed, and thoroughly tamped.

Mortar to be composed of equal parts of pure Portland cement and clean sand mixed with enough water to convert same into a soft paste.

When applied to interior surface and top of vault, to be well worked in with trowels.

The Bureau of Science has proved conclusively that the night mosquitoes found in houses in the Philippines breed only in vaults or cesspools, or in drainage from such places, and in order to make a vault of this type proof against the entrance of mosquitoes which might breed in it, a piece of brass wire netting, 16 to 18 mesh, should be securely fastened over the discharging pipe (KK) and the ventilator pipe. If mosquitoes are found breeding in such a vault, they may be killed by putting one-half cup of petroleum into each compartment every ten or fourteen days until steps can be taken to make the vault permanently tight as suggested above.

SEPTIC ABSORBING AND DISCHARGING VAULT



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Parallel Course Drawing Books. Hammock.

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